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THE TESLA DECISION.

Elsewhere in this issue will be found a very full abstract of the Townsend decision, mentioned by us last week, in favor of the Tesla rotating magnetic field patents which have been in suit for some few years past. It will be seen that the judge treated as insufficient anticipations the work of Baily, Siemens, Deprez and Bradley, all of which had been relied upon and much of which was admittedly of a prophetic character, to say the least. The judge took occasion to compliment Mr. Tesla on the high value of his work to the art, in view of the enormous extension given to the transmission of power by such methods since the distinguished inventor read his memorable paper before the American Institute of Electrical Engineers.

THE INTERNATIONAL ELECTRICAL CONGRESS.

The Electrical Congress of 1900 has joined its predecessors in history. It has been noteworthy in many ways. There are said to have been no less than 350 different congresses in Paris this year in connection with the exhibition, so that the 18th of August was the only date available for securing Congress Hall. Nearly 1150 members are said to have joined it and paid their dues. The organization was good, many of the papers were printed and distributed in advance, and the daily bulletin of the preceding day's work was well maintained and circulated. On the other hand, the quarters provided in the rue de Rennes were inadequate and overcrowded, so that one section was held in the rue de Grenelle, more than half a mile off, which was a great drawback. Moreover the French custom of breakfasting soon after 11 a. m. is calculated to play havoc with a congress of this kind. In order to do any reasonable amount of work the hour of convocation was set for 9 a. m. daily. This being rather early, many did not arrive during the first half-hour. The result was that since adjournment usually occurred at 11 o'clock all the daily proceedings had to be crowded into a space of less than two hours, to the detriment of discussion, the afternoons being devoted to excursions and visits of electrical interest.

The action of the International Congress in regard to electromagnetic units cannot fail to give satisfaction to the members of the American Institute of Electrical Engineers. Two of its four magnetic units, provisionally adopted in 1894, have now received official indorsement; namely, the c. g. s. unit of flux intensity or "gauss" and the c. g. s. unit of flux or "weber," except that the name "maxwell" has been substituted for the name "weber." It can now only be a question of dates as to when future congresses will give names to further units in the c. g. s. system. Considering the great opposition displayed by European delegates at the Chicago congress to giving names to c. g. s. units, and to the marked conservatism felt by European electricians in this direction, their accession to the American request is a great compliment to the A. I. E. E.

The reason for changing the name of the c. g. s. unit flux from "weber" to "maxwell" was no doubt because it would be undesirable to have the names of German scientists for both of the only two units denominated this year. The term "maxwell" will no doubt be satisfactory to our English cousins, and in America we expect the change will be effected with readiness and swiftness.

It is a curious fact that thus for the second time has the force of circumstances caused the name "weber," for an electromagnetic unit, to be discarded by an international electrical congress. Originally

the word "weber" was used for the practical unit of electric current, but the Paris congress of 1881 replaced the name by "ampere." The A. I. E. E. provisionally adopted the "weber" for the c. g. s. unit of magnetic current (flux), and again it so happens that the Paris congress of 1900 substitutes the name "maxwell." Under this adverse fate, which is largely fortuitous and not contemplated or critical, it is to be expected that the name "weber" will rest in undisturbed repose for some time. Meanwhile, on the principle that the king is dead long live the king, we may content ourselves with the cheerful reflection that a gauss is a magnetic flux density of the same order as the earth's flux density which aligns the compass needle, and that a gauss is also a maxwell divided per square centimetre.

THE PARIS EXPOSITION.

The Exposition of 1900 at Paris is in one sense a World's Fair, just like that at Chicago in 1893, since all such displays set forth much the same materials, illustrate the same arts and exemplify the same industrial practices. In another sense, however, the Paris Fair is quite unlike the Chicago Fair. At Chicago the topographer, landscape gardener and architect had practically carte blanche to build as they pleased, and where they pleased, within the limits of the wide and practically empty Jackson Park. In Paris, as we pointed out last May, the designers were limited and hedged in by street and river and circumstance. The result was that at Chicago the scenic effect was the chef d'œuvre, and the grand assemblages of structures bade the visitor stand off and wonder. Viewed too closely, the details of emblazonment were deficient. There was so much, and yet more, to decorate. At Paris the buildings are less massive and less tall, excepting, of course, the pre-existing unequaled Eiffel Tower; but the great charm lies in their decoration and embellishment, so that they seem to bid the visitor approach to examine and admire. The façades of some of these Exposition buildings, as already represented photographically in our pages, are singularly handsome and rich in detail.

Another contrast between the Paris and Chicago fairs lies in the relative degree of prominence given to the artistic and industrial productions. At Chicago statuary and paintings, the work of the hand, were relatively eclipsed by the work of machinery of every kind. At Paris the pictures, statues and works of art form a conspicuous and prominent part of the whole display, and much of it will, fortunately, be permanent. One may say that the Paris Exposition, taken for all in all, is a thing of beauty, and that some of its best will be a joy forever.

As regards the exhibits and the awards, America has certainly done her share, and not the least in what concerns electricity. The fact is that so much now concerns electricity that a segregation into a purely electrical class becomes more and more difficult at each succeeding exhibition. Not merely in Machinery Hall, or in the Electricity Building, does one see electrical apparatus; but also in connection with shipping, gunnery, heating, chemistry and a host of minor classes. The ubiquity of electrical applications is but another name for their utility. There is scarcely a building that does not contain, in some machine or display, a herald of electric conquest over industrial difficulty

Concerning dynamo-electric machinery, there is a curious realization. In preceding exhibitions, notably that last previously held in Paris, the types of dynamos were many and the competition among them keen for preferment. The types now on view in Paris are comparatively few. Evolution seems to have here brought about a node in the vibrating cord of industrial development. The large machines are nearly all multipolar dynamos direct-connected to an engine. Many of these multipolar alternators are multiphases and have stationary armatures with revolving field frames. It is curious to see how many types of multiphase apparatus are exhibited, differing mainly in details of structure. The three-legged, tri-phase transformer was a familiar spirit, while here he hardly abides.

BAD CABLE OPERATION.

Complaint has lately been made of serious confusion and obscurity in the cable despatches from China because they were not dated by Mr. Conger or General Chaffee. As usual, the idea that the cost of a word would be saved has led to the expenditure of many additional dollars, and it is to be hoped that henceforth, in times of emergency at least, our representatives at the front will be told to date their cable messages and sign them. Aside from this detail, it has been quite impressive to see how much guessing the Chinese cable messages in general have caused. We have noted despatch after despatch full of queries, blind places, guesses, varied readings, etc. It is true that many excellent persons have been called upon to cable who never cabled before, but we must confess a suspicion in our own minds that a large part of the dubious meaning is due to the vicissitudes undergone by the messages in passing from cable to cable, from hand to hand, from one country to another. These incidents are but another proof of the necessity of an American cable to the Far East.

TESTING ELECTRIC BOATS.

The past week has witnessed some interesting work in the testing of electric boats. The tests have been of a very different nature, and one of them quite laughable. There is an electric launch in Central Park, this city, and a large bet was offered the proprietor that twenty fat men could sink her. The bet having been taken, the selected cargo got on board, ready for sacrifice, but the launch stood the test admirably, and the 300-pounders all escaped the ducking which their temerity merited in the dirty waters of the lake. Electrical apparatus has to sustain many abnormal strains, and is generally not supposed to be commercial until it is fool-proof, but in this instance it had to be fat-proof also.

The other test has been of the submarine boat Holland at Newport, but the reports are not such as to give much information, and presumably the full details would not be made public by the naval authorities. So far as one can make out, a good deal of importance and of time was given to the detection of the Holland by the searchlight when she was made to travel awash. If this actually be so, the Newport test seems on a par with that in Central Park, for the merits of a submarine boat lie largely in her submersion rather than in running awash. However, fuller reports of what was really wanted and actually accomplished will be welcome.

ELECTRICITY AND CONSUMPTION.

It appears that at the recent Paris International Electrical Congress it was decided that several papers offered in the Section of Electro-Physiology dealing with the use of electricity in the cure of tuberculosis had no direct relation with electrical science, and they were therefore considered not acceptable. This decision must be broadly commended on many grounds. There are probably very few scientists or engineers participating in an electrical congress who could discuss such a topic with full knowledge, and the papers offered would all have far more reason for presentation before a body of therapeutists.

We are glad to note that the American Electro-Therapeutic Association, at its meeting in this city during the present month, will devote practically a whole session to papers and discussions on elec-

tricity in tuberculosis and present methods of treatment. A clear pronouncement from them on the subject may well be asked. So far as we can judge, vain hopes are being aroused in many instances by reports of alleged marvelous cures, and consumptives or their friends are in many instances being induced to part with money that can often be ill spared, besides being a sadly useless expenditure. The association has a great duty and opportunity before it in letting the public know how much or how little of truth there is in these stories of cure, as investigated by its members. When we recall what a scourge the disease is of the human race, there is no wonder that any remedy, however chimerical, is welcomed.

A PLEA FOR THE DYNAMOTOR.

Mr. Adams' article comparing dynamotors with motor-dynamos shows that the former are superior in several ways, but that the difficulty in regulating the secondary pressure in dynamotor use brought the other machine into greater favor. There are certainly some very meritorious features in a dynamotor. It is compact and self-contained, whereas a motor-dynamo is, like its name, a compound quantity with the two parts tied together. The only advantages that we think can be urged for the use of two separate machines mechanically coupled, are those of secondary pressure regulation, readier replacement in case of injury, and insurance of insulation between primary and secondary circuits by means of an insulating coupling. In all other respects the double-wound armature in a single magnetic field is much to be preferred. The dynamotor runs with but very little stress, the torque of the rotor about its axis being only that necessary to overcome magnetic and mechanical frictions; and if the frictions could be suppressed entirely, the machine would not have to exert any torque. The shafts of a motor-dynamo couple have to exert, either as deliverer or receiver, the full torque of a machine of that size. For noiselessness, smooth running, sparklessness and convenience, the dynamotor has no equal; but unfortunately it is so rigid in its conceptions of the ratio of pressure transformation.

ATMOSPHERIC ELECTRICITY.

One of the most interesting papers under discussion at the International Physical Congress was a careful review by Prof. Exner of the state of our knowledge of the phenomena and causes of atmospheric electricity. It is a subject which has been the cause of many a painstaking investigation, and the theme of many an ingenious theory, yet in spite of all this it still remains, like terrestrial magnetism, a discouraging puzzle even here at the dawn of the twentieth century. To tell the painful truth, electrical science is to-day in a state comparable with that of astronomy near the close of the dreary centuries that waited for Copernicus and Newton. Of the phenomena and the proximate causes which affect them we know much, and in imposing detail, but to the basic laws, the fundamental truths that lie below the phenomena, there is as yet no key. Even the primal concepts of theology might be said to be of scarcely more hypothetical intangibility. We live on a globe surcharged with electrical and magnetic stresses, but of what kind and why we do not know.

Prof. Exner sets forth with impartial clearness the data as we have them and the theories which have been more or less imperfectly fitted about them. The main facts in the case are tolerably well known. From the earth's surface upward there is a potential gradient, on the whole from positive to negative, of the order of magnitude of one hundred volts per metre, profoundly disturbed by meteorological conditions, and by local causes quite beyond our ken. On this uncertain basal plain is superposed an annual variation nearly as large as the principal quantity of irregular magnitude, but showing a maximum in winter and a minimum in summer. To complicate the matter still further, there has been generously added a diurnal variation sometimes little smaller than the annual one. This variation is not simple and consistent, but appears in three distinct forms—a double diurnal oscillation with maxima somewhere about 8 a. m. and 8 p. m., and minima roughly half-way between them; a single diurnal oscillation with a sharp minimum in the neighborhood of 5 a. m. and a somewhat vague maximum during the hours of daylight; and finally a condition in which there are no maxima or minima well defined or worthy the name. Moreover, the diurnal oscillation has often been found to be double in summer and single in winter, and, to add to the confusion, at the same locality and time double oscillations have been observed near the earth and single oscillations a few thousand feet higher. In addition there have occasionally been noticed in places where there is no well marked diurnal variation at all, sudden intense maxima of only a few minutes duration, at sunrise and sunset. At great heights very considerable variations have been noticed, sometimes increasing, at other times diminishing, the normal gradient. And all these data are liable to sudden and very violent variations during storms.

It is not a very promising outlook for a generalization, and it is small wonder that little progress has been made. Perhaps tidal phenomena furnish the nearest analogue, but in these one has the advantage of pretty definite knowledge as to the real cause, which is absent in the case of atmospheric electricity. Terrestrial magnetism, too, while in a most unsatisfactory state, is less complex in its normal variations. It seems quite obvious that if the mystery of atmospheric electricity is to be solved, the first step is a far more systematic collection of data than has yet been undertaken. There seems small hope of a solution except by the co-operation of a large number of observing stations well scattered over the earth's surface. The electrical atmospheric conditions are so closely allied with local weather disturbances that it would seem well worth while for the weather bureaus of the nations to make a collective effort to straighten out the tangle, and to gather concurrent data as to the first important step. As to present theories, they are many and diverse, all based on the general condition of a negative earth-charge, but differing as to its cause and exact effects. Aqueous vapor acting convectively, the action of photochemical radiation upon the earth's surface, or upon ice spicules in the upper atmosphere, temperature variations, combustion and other organic phenomena—all these have been advocated as plausible explanations of the discordant facts, which, as Prof. Exner points out, seem to agree only in refusing to fit the theories. The most recent hypothesis is based upon the ionization of air as indicated in some of Prof. J. J. Thomson's beautiful experiments. Granted this, since the negative ions have higher velocity than the positive, an insulated body in ionized air is negatively charged, while the air must contain an excess of positive ions. But even this theory fails to fit some of the facts, and it remains yet to be proved that air at ordinary pressure and temperature can be regarded as ionized.

So for the present, we must record the grim old essentially Scotch verdict of "Not proven." It only remains for some one to work up Thomson's hypothesis of extra-atomic corpuscles in this connection; but with that profound respect for Maxwell's brilliant successor, which is assuredly his due, it seems to us that there is a superabundance of epicycles. It is sometimes apparently easy to explain one mystery in terms of another, but in the progress of science minute analysis is usually only the means to a generalization, as simple as it is profound. The time is swiftly ripening for the man, but until he comes, or if come, reveals himself, the ordinary investigator can only take to his bosom the solace of the brother sage, who "Heard great argument, About it and about, but evermore, Came out by the same door where in I went."

Annual Meeting of the Canadian Electrical Association.

Kingston, Ont., picturesquely situated at the extreme end of Lake Ontario, at the mouth of the river and close to the Thousand Islands, was the scene of the tenth annual convention of the Canadian Electrical Association, which was held on Wednesday, Thursday and Friday, Aug. 29, 30 and 31. The city of Ottawa had originally been selected as the place of meeting, the time fixed being June 28, 29 and 30, but, on account of the great fire which destroyed a vast portion of that city a short time ago, it became necessary for the executive of the association to make fresh arrangements.

At the opening of the convention, which was presided over by Mr. A. A. Dion, Ottawa, president of the association, Mayor Minnes delivered an address of welcome, followed by Alderman Donnelly and Mr. E. J. Pense, president of the Board of Trade.

The president, Mr. A. A. Dion, delivered the annual address, which was listened to with a great deal of interest by those present. He said it was a source of gratification to him that the membership of the association continued to increase, in spite of the fact that a considerable number of members were dropping out of the association every year. He thought the best efforts of the association should be put forth to prevent, if possible, these annual lapses, and that they should not rest satisfied until every electrical operating, manufacturing and supply company, firm or individual was represented on the membership roll. In this connection he submitted for earnest consideration the advisability of introducing into the constitution a feature of company membership such as that carried out by the National Electric Light Association of the United States, in addition to the individual memberships, which could remain open to those who wished to avail themselves of them. This might be a means of interesting in the work of the association many companies who now take no part in it, although all receiving practical benefit from it.

He referred briefly to the achievements of the legislation committee, which had been of incalculable value to the members of the association. Through their untiring, timely and well-directed efforts the "Conmee Bill," which was in danger of being ruinously amended, was reaffirmed by the Ontario Legislature, and was now likely to remain permanently on the Provincial statute books. He thought the committee should be continued for the purpose of watching any legislation unjust to electrical interests which might be introduced in the legislatures. He commended for serious consideration the work of the committee on standardization of accounts, and thought if companies could agree on some general plan of distributing operating expenses, and would furnish their figures to some committee of the association, it would be possible to circulate among the members comparative statements of expenses, omitting names and amounts and giving percentages only, which would enable managers to test the economy of their management and apply the pruning knife where necessary. If all companies would agree to make their annual reports of revenue and expenses on the same basis, especially as regards interest, depreciation and charges of that nature, and publish their statements, it would be possible to ascertain the true percentage of net profits in each case, and this would tend to remove from the minds of municipal legislators the impression often prevailing that there are enormous profits in public services such as electric lighting. He stated that the above considerations had been suggested to him during his attendance at the recent convention of the N. E. L. Association, which had appointed a strong committee to deal with this question.

During the past year electrical industries in Canada had continued to enjoy a reasonable amount of prosperity, and the year had been marked by extraordinary activity and progress, many new and extensive electrical works had been carried out and everywhere there had been evidenced the greatest confidence in the future success of electrical undertakings. He thanked the members for the confidence reposed in him during his presidential year, and wished the association continued prosperity and success in the various spheres.

The committee on meter inspection reported that they had obtained from the Government the concession that whenever a meter requires inspection before the expiration of the five years covered by the last regular inspection, it shall be certified by the department for a fee of 50 cents only, instead of the regular fee. This, while it effects a saving to the companies, is also an evidence of the desire of the department to meet the electrical companies half way, and make the operation of the act as little irksome as possible. The reports of the committees on statistics, legislation, meter inspection and fire underwriters showed that good work was being done which would in time bear fruit. The secretary-treasurer's report showed an increase in membership, there being 213 active and 31 associate members on the roll.

The papers read were of a high order, and were discussed with much interest by the members. The papers read were "Conditions Affecting the Wave Form of Alternators," by Prof. L. A. Herdt, McGill University, Montreal; "Power Factor as Affecting Operation and Investment, with Special Reference to Induction Motors and Enclosed Arc Lamps," by F. H. Leonard, Jr., Montreal; "Rotary Converters," by Mr. A. Gordon Grier, Montreal; "Use of Dynamo and Storage Battery in Telegraph Offices," by Mr. W. J. Camp, C. P. R. Telegraph Company, Montreal, and " Railway Subject, giving several curves showing up the average power during a day, and maximum and minumum requirements for power called for on the Quebec system," by Mr. Blair, Quebec Railway & Lighting Company.

The discussion of the suggestion in the president's address as to company membership and the question of a fixed contribution by companies for the purposes of the legislation committee, resulted in a motion to refer the matter to the executive and legislative committees jointly, with power to them to adopt whatever means they may deem advisable.

On the discussion of Mr. Leonard's paper on "Power Factor and Enclosed Arc Lamps," Mr. Leyden, of Hamilton, stated that his company had made a number of tests on their arc lighting circuits, and it was found that the power factor varied according to the number of lamps that were connected on that circuit; he said: "If we get all the arc lamps the circuit will possibly carry, we get a power factor of about .85, and it drops down very rapidly as you take the arc lamps off your circuit. We run a pressure of 2400 volts; on that we should be able to burn, theoretically, some 33 arc lamps, series enclosed; if we got the full 33 on, I think we would have a power factor of somewhere about .90 or .91, but we find that the circuits will not work well when we put the full number on, and we get better operation by cutting it down to about 30; that has also the effect of reducing the power factor down to about .85. So that both sides of the question have to be considered. I think the expense which you save and the economy which you gain and the simplicity of your system certainly overbalances any evil effect of this low power factor, especially when you take into consideration that at certain times of the day when this power factor annoys you the most by having some synchronous motors on your line you can to a large extent overbalance the difficulty. Synchronous motors in large sizes I consider to be a very reliable, very handy and convenient piece of apparatus to have on your circuits." On the question of open and enclosed arc lamps, Mr. Leyden said he had become thoroughly convinced that for the same number of watts consumed in an alternating enclosed arc lamp, having a proper reflector above it, that a more satisfactory street illumination was obtained than from the old-fashioned arc lamp, direct current. He stated that they had had the enclosed arc lamps burning in the city of Hamilton since last Christmas, and they had never had a complaint; on the contrary, they had many times been complimented on the satisfactory illumination given.

A number of central station men also testified to the satisfaction given by the enclosed arc lamp in comparison with the open arc lamp.

On Friday morning the election of officers and members of the executive committee took place, resulting as follows: President, A. A. Dion, superintendent, Ottawa Electric Company, Ottawa; first vice-president, E. E. Cary, manager, Packard Electric Company, St. Catharines, Ont.; second vice-president, P. G. Gossler, Royal Electric Company, Montreal; secretary-treasurer, C. H. Mortimer, *Electrical News*, Toronto. Executive committee: Messrs. A. B. Smith, O. Higman, D. R. Street, J. J. Wright, B. F. Reesor, F. W. Simmons, W. H. Browne, J. W. Camp, John Yule and Edward Slade.

The convention then adjourned to meet in Ottawa in 1901.

Electrical Works in Germany.

Consul-General Guenther, at Frankfort, says: "According to the Electro-Technical Gazette, German electrical works show great increase. On March 1 last there were in operation 652 electrical works, against 489 the previous year. One hundred and twenty-two works were in progress of construction, of which 17 were to be ready for operation July 1. Twenty-seven of all the works were completed before 1890; all the others were constructed within the last ten years. The number of places with electric light exceeds that of places illuminated by gas—900 against 850. All the electrical works supplied last year 2,623,893 incandescent lamps, 50,070 arc lamps, 106,368 horse-power for motors, etc.

How Can Central Stations Earn Larger Revenues?—II.

BY ALBERT B. HERRICK.

IN the opening portion of this article we considered the general subject of ways and means for increasing the revenue of central stations, and took up for treatment first the subject of steam heating, and the utilization of exhaust, etc. We come now to the discussion of pumping, a subject which has by no means received the attention that is due it.

Pumping water for city water works is the chief item under this head, where there is storage at an elevation to give the proper pressure, either the whole supply or pumping for the high pressure part of the system only. Pumping under the Holly system will bring this load on top of the peak, and a motor is hardly adapted to this character of load; but with a reservoir with a day's supply capacity the pumping can be done during a period of low loads.

Taking up the same load curve as was discussed in steam heating (Fig. 1 reproduced here for convenience of reference), there is an average of only about 16 hours per day when this load could be carried with profit. To find the aggregate station cost, the total watt output per month, divided by the revenue, gives the average selling price. All cost, including the fixed charges, labor and supplies, divided by the units produced, gives the cost price.

Supposing that 150,000 cu. ft. per day raised 166 ft. with 10-ft. suction could be obtained, this would require 60-hp output for about 1000 minutes per day, which would be at such times of delivery as not to interfere with the maximum output of the station. The cost of this pump installation, with a duplicate set of pumps and motors, their placing and connection, would be about $9500. To this should be added a special feeder from the station so the load could be taken on and off under the control of the station operator. This 60 hp would require the running of an extra engine two hours per day for three months in the year—November, December and January. The rest of the time this 60 hp would put a more efficient load on the operating unit, and increase the gross economy of the plant. The items that should be figured against this load are: extra coal, oil and depreciation, the interest on the pumping plant, lines and attendance.

A triplex pump at 40 revolutions will not produce any fluctuation

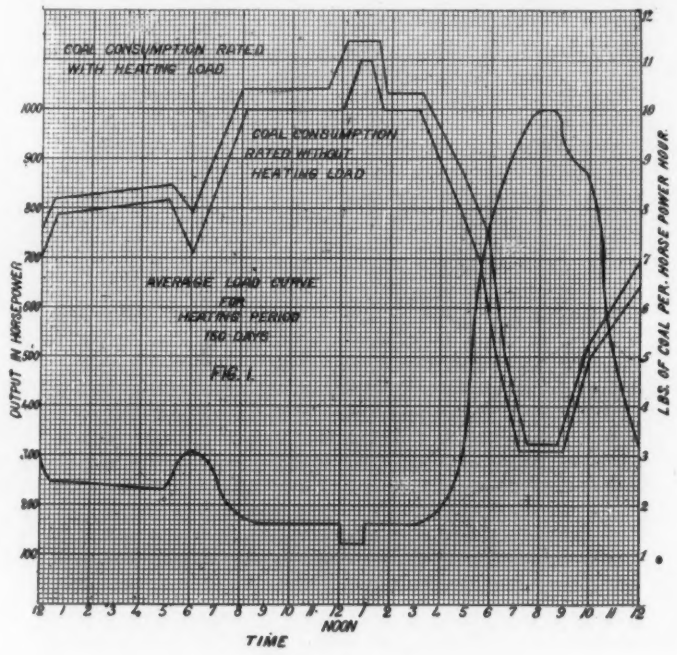
COAL CONSUMPTION RATED WITH HEATING LOAD
COAL CONSUMPTION RATED WITHOUT HEATING LOAD
AVERAGE LOAD CURVE FOR HEATING PERIOD 150 DAYS
FIG. 1.
OUTPUT IN HORSEPOWER
LBS. OF COAL PER HORSE POWER HOUR
TIME
NOON

FIG. 1.—LOAD CURVE.

in a direct current system, and, if sufficient fly-wheel inertia is added, with an induction motor, will average out any pulsations which may cause pumping action on the lines. The starting rheostat could be located at the station if the precaution is taken of putting in an automatic valve at the foot of the discharge pipe which opens electrically when the current is off the line, so that the pump starts up without bucking against a standing head. This also requires a free discharge on the upper end of the discharge pipe.

Fig. 3 shows the effect of this load on the mean annual load curve of the station; and the total extra coal required for its maintenance will be two tons per day at 365 days per year.

The items figure out as follows:

Interest on pump investment, $9500	$570
Interest on lines and installation approximate	175
Labor	220
Extra coal, at $3—730 tons	2190
Extra engine for 180 engine hours	360
Depreciation, taxes and repairs	420
Total	$3935

This plant could raise per annum 54¾ million cu. ft. of water. Fourteen cents per 1000 cu. ft. have been obtained for this service,

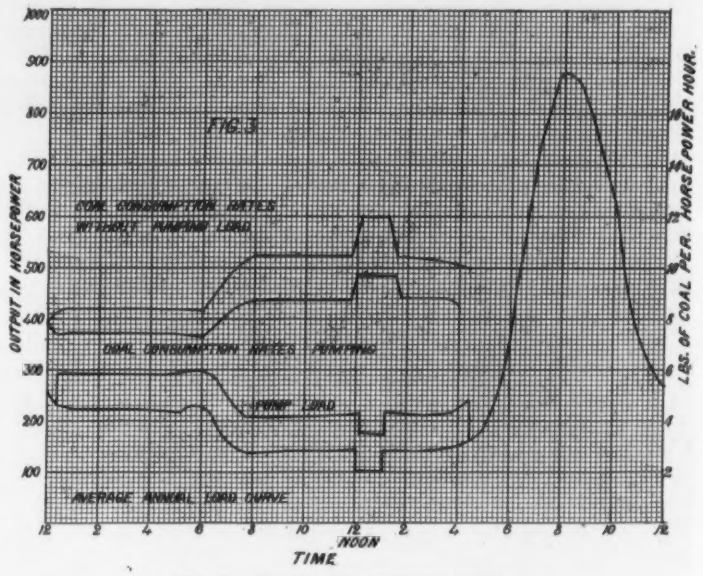

FIG. 2.—CURVES OF PUMPING LOAD.

giving a revenue of $7665 per year, or over $100 per horse-power per year. Yet an isolated steam plant could not pump this water at costs which an electric service can offer with a resulting profit to the lighting company, and this is why central station managers should pay greater attention to the possibilities for them in this field of work.

National Guard Signal Corps.

At the Military Tournament held at West End, N. J., on the grounds of the Monmouth County Horse Show Association, Aug. 24 and 25, a feature was a contest between the Signal Service men of the National Guard of the States of New York and New Jersey. This consisted of a telegraph pole climbing contest, which had for its object the testing of the capacity of the men of the Signal Service of these States in overhead telephone and telegraph line construction. In front of the grand stand were erected two ordinary 40-ft. Western Union chestnut poles, and 30 ft. from the ground was driven a spike so as to protrude 12 ins. At the base of the pole on the ground were placed a number of rings, and the contestant who succeeded in placing the greatest number of rings on the spike at the pole within three minutes won. The contestants were equipped with ordinary lineman's climbers. There were eight entries, all from the State of New York, but only five of those entering competed. The trophies were beautiful medals, gold for first, and silver for second. The first was won by Corporal M. C. Sullivan, First Signal Corps, N. G. N. Y.; the second by Corporal F. W. Smith, Second Signal Corps, N. G. N. Y. Governor Voorhees was present as commander-in-chief of the military forces of the State. The contest, aside from its intensely practical relation to the military service, proved to be one of the most interesting features of the show to the audience. This contest is the second of the kind that has ever taken place anywhere, the first being held at the Madison Square Garden Military Tournament last spring, and it shows the progressive spirit of the authorities of the Signal Branch of the military service. In this connection it is interesting to note that the English journals attribute the celerity with which special news has reached America from China and the battlefields there to the fact that the United States Signal Corps have been erecting field wires and have a staff officer assigned to the special duty of collecting and sending news.

Special Lighting Effects at the Paris Exposition.

FIG. 1.—ALGERIAN DOME.

Next to Electricity Building comes the Eiffel Tower as a leading feature among the night effects at the Paris Exposition. There is, as has already been noted in these pages, a great deal of miscellaneous lighting, and detailed reference will be made to that presently, but it is remarkable that so few of the buildings erected by the Exposition authorities should be distinguished by electric light illumination. Wherever one goes, the row of gas jets is to be seen, and most of the lanterns in the trees burn with a wick. This appears to have been intentional from the start, for the service plant would have proved utterly inadequate to the task had all the illumination effects been made electric.

To see Electricity Building, you have to be in the quadrangle of the Champ de Mars section of the Exposition, and to see the electric fountains you have to get a very good nearby standing place. But the illuminated Eiffel Tower dominates its surroundings for miles, and certainly gains in beauty at night when its harsh structural details are no longer seen. Our view of it in one of the night photographs herewith (Fig. 2) was taken from a considerable distance along the River Seine, and is highly suggestive of the manner in which it is outlined by its incandescent lights against the dark sky, with its flashing projector beam at the very crest.

At the Exposition of 1889, the firm of Henri Beau undertook for the Exposition authorities the illumination of the Tower by gas, in spite of predictions as to failure. As a matter of fact, M. Beau succeeded in installing 4000 gas jets on the spandrels at the base and on the three platforms. The effect was pretty in a way, but, of course, was detached and broken. This time the administration of the Tower —now a private enterprise, and not operated by the Exposition—decided to employ electricity, if possible, in accentuating by night the principal lines of the whole structure, and the work has been very successfully carried out by the same house that made the interesting attempt with gas eleven years ago.

FIG. 2.—EIFFEL TOWER AT NIGHT FROM RIVER SEINE.

Various experiments were tried in order to see how to produce the best effect with the fewest lamps and with lamps of the smallest candle-power. Lamps were tried with outer globes of celluloid, etc., with very good results, but finally bare lamps with a reflector behind them were adopted. These reflectors can be seen in Fig. 3, which shows one of the four huge feet of the Tower. They are in general of white metal, paraboloidal in form, with an opening of 30 cm, and corrugated. Each reflector holds a lamp of 10 candle-power. The crinkled edge of the cup, with the lamp in the centre, gives a pretty rosette-like appearance to each fixture. The reflectors are not, however, as might be thought, mounted singly, but are made up in strings about 42 ft. in length, which, by means of steel cable, are applied along the faces of the structure and held there firmly in place, from point to point, so that they cannot break loose. The lamps and reflectors are also screwed firmly into watertight rectangular base plates, the whole being made entirely waterproof. From first to last by this method there was no necessity to pierce or damage any part of the metal of the Tower itself. The renewal of any dead lamp is easy, it being only necessary to let free the particular string of lamps by loosening up the clips that hold the lower ends of the steel cables. The string can then be pulled up, the bad lamp unscrewed and a new one fixed in, and the string lowered again into position. Each string complete weighs about 35 lbs., and can be easily handled by two men, being, as will be gathered, very flexible. It was proposed at first to mount the lamps and reflectors on long, heavy planks of wood, but danger was feared from their possible dislodgment and fall. Should one of these "garlands" or strings of lamps slip out of its fastenings, which is hardly likely, it would inevitably be hooked in its downward flight by some lower part of the structure.

The lamps number all told about 4100 and are divided up into 13 circuits which run from a switchboard placed in the vast cellar under the south foot of the Tower. Current is generated by direct current apparatus and delivered at 130 volts, with a drop of 10 volts to the intermediary stage and 20 volts to the summit of the tower. The insulation resistance of feeders and circuits is maintained very high, owing to the metallic mass on which they rest, and the incessant exposure to the elements.

There is a strong light in the campanile, and it may, perhaps, be detected from Fig. 2 that there are small projectors at the base of each limb. These send a beam of light up from the foot of each tower on the outside, creating a rather unusual glow effect that causes the

FIG. 3.—ONE FOOT OF EIFFEL TOWER, SHOWING INCANDESCENT LIGHTING.

Tower to loom up even when the incandescents are not in operation. The plant was one of the first to be ready, and the Tower was lit up with all its lamps on April 14, much to the delighted surprise of the public. Not only are the Tower and the restaurants, etc., at the various platforms thus lit up, but from time to time the beams of outside searchlights are thrown upon it, constituting a picture that the eye rests upon and continually returns to with pleasure.

We show also a few of the illuminated buildings. Some smaller pavilions are illuminated, while many larger ones are left in darkness. The United States National Pavilion, for example, carries a number of incandescents around its dome, but the lower bulk of the building

is untreated, from the illuminative standpoint. The stately cathedral hall of Italy is also without ornamental light, as are the quiet baronial hall of England, the palaces of Germany, Austria, etc., although they may have ordinary interior lighting at times of fête, receptions, etc. The result is an unevenness along the water front in the grouping is that the smaller Street of Nations areas of darkness alternate with dazzling displays, and without any uniformity of plan or design. But, as out photographs show, where the incandescent lamp is used it is used lavishly, even though there be no great originality about its employment. In this respect one of the prettiest and most

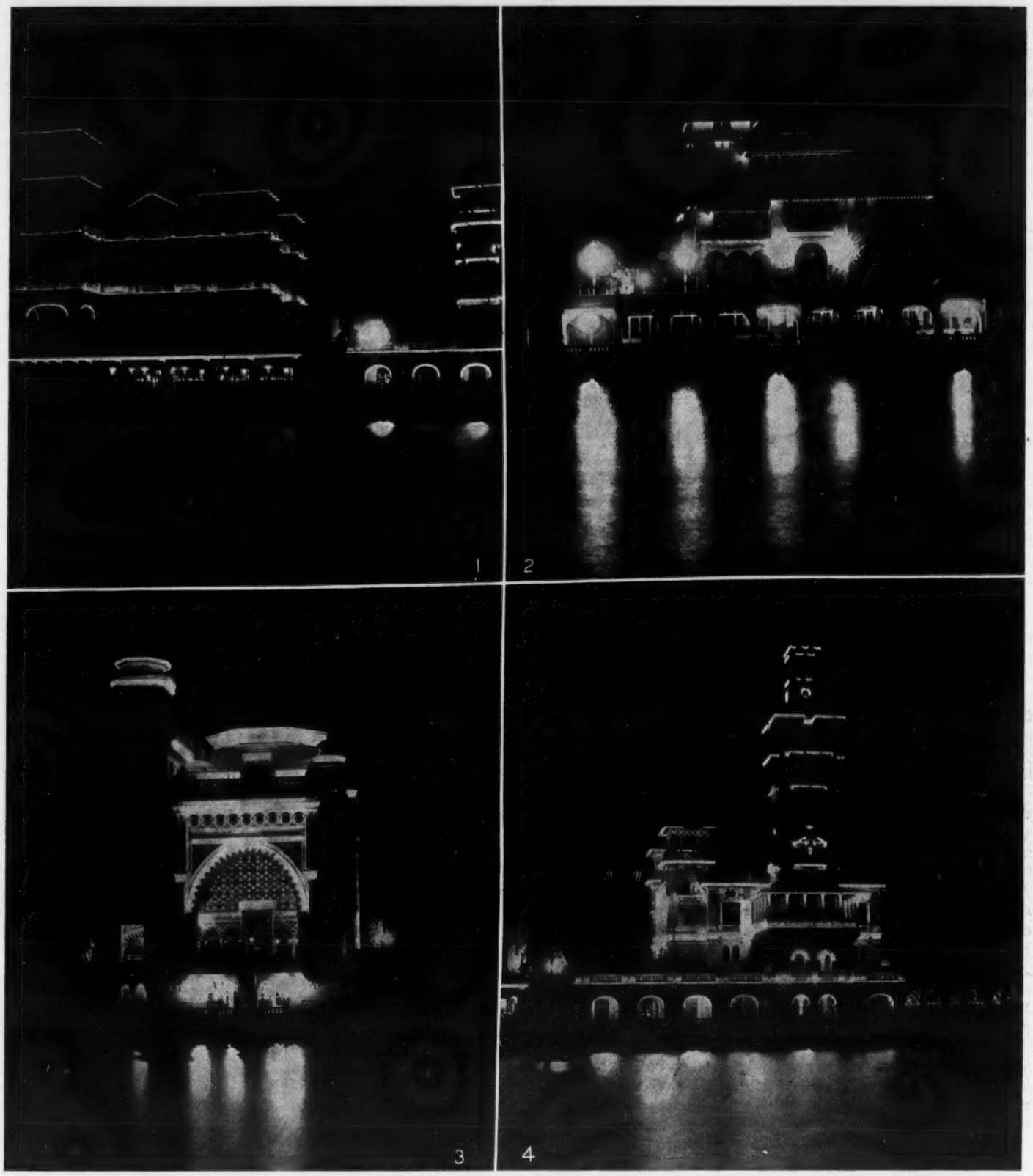

FIG. 4.—NIGHT EFFECTS, PARIS EXPOSITION STREET OF NATIONS.

NO. 1.—SPANISH BUILDING.
NO. 2.—BOSNIAN COURT.
NO. 3.—TURKISH PAVILION.
NO. 4.—PALACE OF MONACO.

picture, Fig. 4. These are all taken from the Street of Nations on the Seine front. No. 1 is the Spanish National Pavilion; No. 2 is that of Bosnia; No. 3 is that of Turkey and No. 4 is that of Monaco. Only part of the Turkish building is visible, due to the concentration of light around the portico, as will be noted, where an excellent effect is obtained by masking the incandescent lamps behind a characteristically Oriental glass and metal grille. Another feature to be noted in passnovel effects is that created by the Algerian Building (Fig. 1) in the French colonial section on the Trocadero hill slope, as illustrated in the vignette of the dome at the beginning of this article. There the dome shell is pierced with a large number of incandescents of small candle-power, grouped all over the convex surface in patterns and also outlining the structure, and the result is very charming and successful.

Electrical Engineers at Paris—Receptions and Visits.

On Monday, Aug. 20, the president and members of the American Institute of Electrical Engineers in Paris gave a reception from 5 to 7 p. m. at the United States Pavilion to about 300 invited guests, principally the British, French and other foreign attendants on the International Congress. Music and refreshments had been provided for the occasion, which passed off very successfully. The same evening at 9:30 Prince Roland Bonaparte received the members of the congress at his sumptuous hotel on Avenue de Jena.

On Monday afternoon one party of members of the congress visited, by invitation, the generating station at St Denis of the Continental

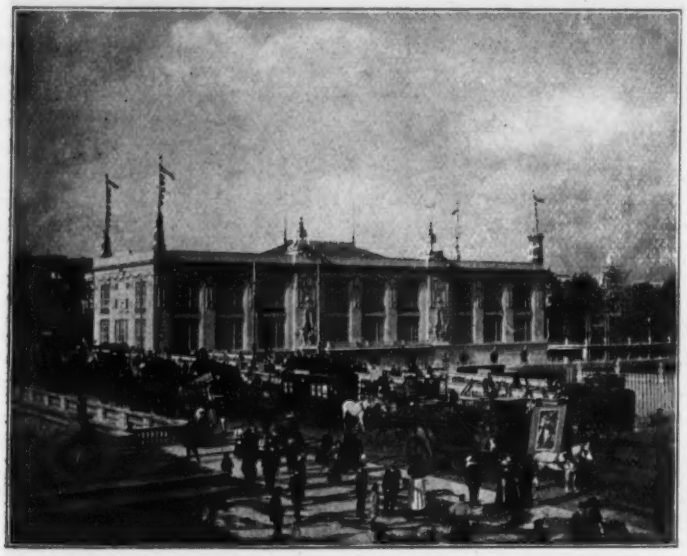

FIG. 1.—HALL OF CONGRESSES.

Edison Company, and another was escorted through the La Chapelle rectifier sub-station of the Northern Railway Company. This installation comprises a set of three twelve-phase rectifiers with a capacity each of 200 kilowatts. Two-phase current at 6006 volts is brought in from generators at St. Ouen, and reduced to a working pressure for use in the railroad yards and buildings, the continuous current at 115 volts being used for lighting and for charging a battery of accumulators as a reserve.

On Tuesday afternoon the French electrical engineers gave an excursion by special train to the Château de Chantilly, the magnificent gift of the Duc d'Aumale to the Institute of France. Over 400 engineers with their wives and friends availed themselves of the opportunity to visit this historic castle and its great art collections, two special trains being provided. After viewing the beautiful grounds and visiting the magnificent art galleries, catalogues of which were distributed gratuitously, a lunch was served, and the party returned to Paris at 7 p. m.

On Wednesday evening the president and Council of the British Institution of Electrical Engineers received members of the American Institute of Electrical Engineers and invited guests at the British National Pavilion.

The visit of the engineers on Friday to the installations of the Western Railroad proved extremely interesting, and included an inspection of the central station at Moulineaux as well as the sub-stations of Champ de Mars and Invalides. A special train was provided to convey the party from the St. Lazare station to Moulineaux, where they arrived shortly after 2 o'clock, and went through the station, escorted by M. Clerault, chief engineer of the Western Railroad Company, and by Messrs. Mazen and Briant, engineers of the company, who throughout the whole trip afforded explanations and descriptions of the machinery installed. This comprises a complete and extensive system of electric power distribution for use on their Paris lines, supplying current to motors for pumps, air-compressors, machine tools, etc., such as is required for the operation of trains by electricity or compressed air. Electric traction is employed only on the line from the Invalides to Versailles, following the river as far as the fortifications. Compressed air locomotives are for use in the Invalides station for shunting purposes; as a reserve in case of failure of current supply, although such is hardly likely to occur, and also for hauling trains on the city line to St. Lazare. High-tension cables supply current at 5000 volts from the central station to sub-stations located on the railroad line at Champ de Mars, Meudon and Viroflay for power, and at several points to transformers for station lighting. The company has ten electric locomotives, four of which have reduction gear for the motors and six have direct drive. With the intention of giving a fair trial to all commercial systems of traction, the company is also having constructed four compressed air locomotives, which will be used as above stated, being particularly useful for that part of the road which is through tunnel, such as the section under the Street of Nations in the Exposition.

The Moulineaux station has not yet been entirely finished, as it is eventually to have nine engine-generator sets of 800 kilowatts each. Three of these are now in running order, the engines being horizontal triple-expansion four-cylinder condensing, by Dujardin & Co., of Lille, France, and drive 800-kw three-phase 5000-volt revolving-field alternators built by the Westinghouse Company. With the praiseworthy desire above mentioned of practically testing different systems side by side with a view to further extensions at a later day, the Western Railroad has decided to use cross compound engines for the last three generators, cranks being at 90 degs. Excitation is provided by direct connected Westinghouse units, each being capable of supplying current for three alternators, at 125 volts, and running at 290 r. p. m. under 150 lbs. steam. Eventually five of these exciter sets will be installed but two are at present in use, the current being used for station lighting and for operating the cranes. Condensing water for the engines is taken from the Seine and forced by centrifugal pumps, motor-driven, into a large tank, the return flow being through special pipes by gravity. The boilers, by Mounier, of Lille, are ranged down one side of the main building, separated, of course, from the engine room by brick walls. There will be 27 boilers when the installation is complete, each with a heating surface of nearly 2700 sq. ft. Coal is delivered by cars on rails laid along the front of the boiler room, and is

FIG. 2.—THIRD RAIL SYSTEM, WESTERN RAILROAD, AT THE EXPOSITION.

passed through chutes to the fire room. Ashes are collected in small cars which run in a special tunnel below the boilers. An elaborate set of testing instruments is provided in a building set apart for that purpose, and seemingly more complete in outfit than would usually be considered necessary. One room has a series of panels on which are mounted wattmeters to register the output through the different lines. These outgoing cables are all armored, and carry the three wires, with cellulose insulation. Along the railroad they are placed in a layer of

sand and covered with earthenware plates and additional protective plates. Each sub-station is supplied with current at 5000 volts, 25 periods, by two cables, giving thereby every assurance of uninterrupted service. For the railroad stations current for lighting and operation of small motors is obtained by means of static transformers which reduce the pressure to 100 or 200 volts, and induction motors direct connected to 125-volt continuous-current generators. Each of the sub-stations for power, already mentioned, is similar in respect to apparatus, each having four 100-kw rotary converters, with the necessary three-phase transformers for reducing the pressure to 340 volts, and in addition one small motor-generator set furnishing continuous current at 550 volts for use in starting the rotaries.

From the Moulineaux station the party of engineers was taken by special train to the Exposition station at Champ de Mars. Here a visit was made to the transformer station already referred to, and subsequently to the sheds where the locomotives are stalled. Afterwards a visit was made to the Invalides station, where there is an air-compressing plant for the locomotives, and electric lighting machinery.

The compressed air locomotives are built in Liége, Belgium, the Mekarski system being used. Two heavy four-wheel trucks are used, and a tractive effort of 11 tons may be attained, the reservoirs holding 4000 lbs. of compressed air. The electric locomotives will be used for regular traffic on the Versailles line. Two four-wheeled trucks are used, as on the compressed air locomotives, but the centre of the body is intended to receive baggage, which is a decidedly useful way of arranging this. Controllers are placed at each end, in order that the locomotive may be run in either direction. These locomotives are capable of hauling a train of 200 tons. Electric motor cars are used as locomotives for the light train running between Champ de Mars and the Invalides. Two of these cars are used for a train, one at each end; there are two 40-hp motors on each car, controlled from either end of the train.

It seems to be rather humiliating for an electric motor to be used to drive air compressors for a rival tractive machine but this is what is done in the Invalides sub-station, where three compressors are operated by 5000-volt three-phase motors. Air is taken from the mains at 90 lbs. pressure and stored at 1500 lbs. in accumulators from which the locomotive reservoirs are filled. A battery of boilers furnishes the steam necessary for the reheating of the air for the locomtives and serves at the same time for heating the railroad depot.

The electric railroad building and repair shops are situated a short distance from Moulineaux, and include every apparatus and machine necessary for setting in position the rails, with a forge, rail saw, drilling machine, etc. There are also ovens for impregnating the wooden insulating posts for the third rail and machines for wood working. An interesting apparatus is a car which carries a 50-kilowatt power plant for use in drilling and reaming holes in the rails, mechanism for unloading and laying rails and hydraulic presses for bonding.

Ending the Exposition.

A special despatch from Paris of Aug. 25 contains this information: The committee appointed to organize fêtes at the Exposition in order to galvanize the show into something like brilliancy and thus attract visitors, announces that two great fêtes will be given in addition to the Venetian fêtes already announced. The first will be a fête of flowers, in the first week in Sept., and the second will be vintage festivities, on Sept. 15. The first will be made the occasion for a gigantic flower show and a battle of flowers. The second will comprise an exhibition of French wine products and a procession of allegorical cars. Though it has been sugggested that the show should be kept open until December, it is now decided that as planned it will close on Nov. 5.

Electricity in the U. S. Army.

A school of instruction has been established by the United States Government at Fort Monroe, Va., for the purpose of instructing regulars in the application of electrical machinery used in the army. The rules, published by direction of the Secretary of War, provide that applicants must be under 25 years of age, unmarried, qualified as a gunner, a student of a correspondence school or the owner of electrical books, and no applicant will be recommended unless he has sought for a year or more to become practically familiar with one or more classes of electrical machinery or with some portion of the elementary literature on electricity.

The International Electrical Congress.

(From Our Special Correspondent.)

THE International Electrical Congress of 1900 was opened Saturday, Aug. 18, by an address of welcome delivered by M. Goumeux, Assistant Secretary of State of the French Republic. He referred to the important place which electricity has taken in the industrial world, and predicted that the literature of the profession would be greatly enriched by the proceedings of the congress about to be held, comprising, as it did, leading engineers from every country in the world. At the conclusion of the address, M. Goumeux turned to M. Mascart and in complimentary terms referred to the high estimation in which his abilities were held, not only in France, but throughout the world, in recognition of which, he was deputed to announce, the government had advanced him to the high grade of grand officer in the Legion of Honor—an announcement received with much applause by the audience.

M. Mascart followed the government representative in an address, in which he sketched the development of electrical science and the electrical industry during the past century. He referred to Napoleon's prediction in the day of Volta as to the future of electricity—a future more than realized. Taking up the subject of electrical congresses, he dwelt upon the great work performed by the first congress in 1881, and upon the value of their deliberation to the industry and art.

At the conclusion of Prof. Mascart's address a recess was taken in order to prepare for submittal to the congress a list of permanent officers. In about a quarter of an hour the congress was called to order, and the following list submitted, which was adopted by unanimous vote:

President, Prof. E. E. N. Mascart; secretary, Prof. Paul Janet; reporter, Prof. E. Hospitalier. Vice-presidents: France, H. Moissan, H. Fontaine and E. Gariel; United States, Carl Hering and A. E. Kennelly; Germany, F. Kohlrausch and Dorn; Great Britain, Sir W. H. Preece and Prof. John Perry; Italy, Prof. Colombo; Belgium, Prof. Eric Gerard; Austria, Max Jullig; Hungary, Etienne de Fodor; Russia, Prof. Chatelain; Switzerland, Col. Turrettini.

The congress is divided into five sections, as follows: Section I., Scientific Methods and Measuring Instruments. Section II., Electrical Generation, Transformation, Transmission and Distribution; Electric Lighting and Traction. Section III., Electro-Chemistry. Section IV., Telegraphy, Telephony and Miscellaneous Applications. Section V., Electro-Physiology. Prof. Violle was named president of section I. Section II., on account of its scope, was divided into two sub-sections, with M. Hillairet president of one and M. Hippolyte Fontaine president of the other. Prof. Moissan is president of the third section, M. Wunschendorff of the fourth, and Prof. d'Arsonval of the fifth. It was decided that the organization of the sections would be left to the several sections, which, on Monday, Aug. 20, will name the vice-presidents and secretaries.

At the conclusion of the announcement or organization and of officers, Prof. Mascart gave the programme for afternoons—the sessions proper of the congress to be held in the morning. On Monday afternoon one party would visit the electrical plant at the Gare de la Chapelle of the Chemin de fer du Nord, where the Hutin & Leblanc system is installed, and another, the central station of the Continental Edison Company, at Saint Denis. In the evening Prince Roland Bonaparte tendered a reception at his hotel in Avenue Jena. On Tuesday there would be an excursion to the Château of Chantilly. On Wednesday the compressed air station at Quai Jemmapes would be visited, and the Metropolitan underground road. The following afternoon there would be visits to the Quai D'Orsay terminal station, the Champ de Mars and Meudon electric railway, and the Moulineux power station. On Friday the laboratory of the Ecole Superieure d'Electricite would be visited. This programme was carried out with some little variation. (See other pages of this issue.)

At the conclusion of the opening session Prof. W. E. Ayrton, of England, and Prof. Dorn, of Germany, expressed for the foreign members thanks for the admirable programme arranged and the courtesies extended.

During the session Presidents Hering and Perry, of the American and British Institutes of Electrical Engineers, occupied places at the presiding officer's table, and Mr. A. E. Kennelly and Major Millis, U. S. Government delegates, were seated on the platform. After the meeting the delegates of the American Institute of Electrical Engineers—Messrs. Crocker, Hering, Arnold, Mailloux and Hammer—organized with Prof. Crocker as chairman and Mr. Mailloux

E. SARTIAUX.

as secretary, in order to formally present the propositions of the institutes as to units and nomenclature.

Following is a list of papers to be read, so far as at present officially announced: "Accurate Measurement of Alternating and Polyphase Currents," by M. G. L. Addenbrooke; on the "Excitation of Induction Receiving Apparatus," by Maurice Leblanc; "Photometry," by M. J. Violle; "Electric Furnaces," by M. Keller; "Construction of Dynamo-Electric Machines," by Maurice Leblanc; "Electric Car Current-Taking Devices," "Electromagnetic Mechanisms," by Prof. S. P. Thompson; "Present State of Wireless Telegraphy," by Prof. A. Blondel and Capt. G. Ferrié; "Progress in Electric Lamps," by Prof. A. Blondel; "Electrochemical Deposits," by H. Bouilhet; "Use of Condensers," by P. Boucherot; "Operation of Alternators in Parallel," by G. Chevrier; "Recapitulation of the Decisions of Previous Congresses," by Prof. E. Hospitalier; "Rotary Converters and Current Rectifiers," by Prof. P. Janet. In addition there will be a paper presented by Mr. W. H. Hildburgh on "Asymetrical Conductors;" one by Messrs. Squier and Crehore in "An Improvement in Rapid Telegraphy," and a paper by Mr. Etienne de Fodor on "A System of Charging for Electrical Supply."

The sessions of the International Congress of Electricity for the reading and discussion of papers were commenced Monday morning, Aug. 20—four sections sitting at 44 rue de Rennes, and the section on telephony and telegraphy at the headquarters of the Société d'Horticulture. The first business was the selection of officers other than the president, who had been named at the general meeting on Saturday. Following is the complete permanent organization of the congress:

President, Mascart. Vice-presidents: France, Moissan, Fontaine and Gariel; Germany, F. Kohlrausch and Dorn; Great Britain, Perry, Preece; Austria, Jullig; Belgium, Gerard; United States, Hering and Kennelly; Hungary, de Fodor; Italy, Colombo; Russia, Chatelain; Switzerland, Turrettini. General secretary, Janet; reporter, Hospitalier.

Section I. Scientific Methods and Measuring Apparatus: President, Violle; vice-presidents, Kennelly; E. Arnold, Ayrton, Chatelain and Crova; secretaries, Bourguignon, David and Odent.

Section II., Sub-Section A. Production and Mechanical Utilization of Electricity: President, Hilliaret; vice-presidents, Mailloux, S. P. Thompson, Stroeker and Turrettini; secretaries, Thomine, Grunberg, Grisel, Boisseau and Halphen.

Section II., Sub-Section B. Electric Lighting: President, H. Fontaine; vice-presidents, Hering, de Fodor, Meyer; secretaries, Garnier, Pernollet, Soulier.

Section III. Electro-Chemistry: President, Moissan; vice-presidents, Pagliani and Zenger; secretary, Landrin.

Section IV. Telegraphy and Telephony: President, Wunschendorff; vice-presidents, Gavey, Roosen, Pinter and Strecker; secretaries, Sire de Vilar, Racapé and Lacaze.

Section V. Electro-Physiology: President, d'Arsonval. Owing to the absence through illness of M. d'Arsonval, M. Bergonie presided on Monday, but no selection of officers was made.

After the organization of Section I., M. Hospitalier proposed the appointment of a committee to report on the various questions of units presented to the congress, the report to form the basis of action at a meeting on Friday of official delegates appointed by governments. Following is the committee named: Kennelly, United States; Ayrton, Great Britain; Chatelain, Russia; Dorn, Germany; de Fodor, Hungary; Gerard (Eric), Belgium; De Hoor Tempis, Holland; Hospitalier, France; Lombardi, Italy.

E. HOSPITALIER.

In addition to the list of papers previously given and distributed at the opening session, the following will be read at the congress—few or none of which will probably be in print before the congress adjourns: W. E. Ayrton, "The Candle-Power of the Enclosed Arc;" Blondel and Gigouzo, "The Efficiency of Alternating Arcs;" de Fodor, "New Method of Charging for Electrical Supply;" Hoho, "New Methods for Regulating the Distribution of Heat Disengaged by the Electrical Current on its Passage from a Solid to a Liquid, as in the Lagrange and Hoho System;" De Hoor Tempis, "Electrolytic Incandescent Lamps;" Mornat, "Electric Light and Power in Theatres;" Bede, "New System on Trial at Brussels for Delivering Current from Line to Motor Cars;" Blondel, "On the Theory of Compounding Alternators;" Blondel and others, "Oscillographic Experiments with Alternators;" Blondin, "The Dolter Electric Railway Surface Contact System;" Boucherot, "Compounding of Alternators and Asynchronous Generators—Employment of Condensers;" Claude, "Electrolysis by Railway Return Currents;" Leon Gerard, "Electric Haulage of Boats by Chains;" De Hoor Tempis, "Paralleling of Alternators;" Janet, "Theory and Test of a Single-Phase Rotary Converter;" Lombardi, "Condensers for High Voltages;" Perot, "Effect of Coupling Alternators and Motors with Respect to Harmonics;" Rey, "The Predetermination of the Drop in Alternators by the Theory of Double Reaction;" Semenza, "Tests and Measurements on a Large High-Voltage Installation;" Thury, "High-Voltage Transmission by Direct Currents," "On a New Method of Regulating the E. M. F. of Storage Batteries on Constant Potential Circuits;" Van der Swissen, "Delivery of Current to Motor Cars;" Blondel, "On Oscillographs;" Dompieri, "Decimal Division of the Hour on the Basis of the 1-240,000 Part of the Mean Solar Day;" Hildeburgh, "Asymetrical and Irreciprocal Conductors;" De Hoor Tempis, "Tests of Dielectrics;" Kempf-Hartmann, "Measurement of Alternating Current Frequencies;" Perskyi, "Seeing by Electricity."

F. B. CROCKER.

ELECTRICAL UNITS.

Section No. 1 of the International Electrical Congress assumed charge of matters pertaining to Scientific Measurements and Measuring Apparatus. At its first session on Monday, Aug. 20, M. Hospitalier moved that questions concerning electrical units should be referred to a committee on which one member should be selected from each of the countries represented. The motion being carried unanimously, the following members were appointed on the committee: Ayrton, Great Britain; De Chatelain, Russia; Dorn, Germany; De Fodor, Austria; Gerard, Belgium; De Hoor Tempis, Hungary; Hospitalier (chairman), France; Kennelly, United States; Lombardi, Italy. The committee met on Tuesday, Aug. 21. Its discussions were carried on entirely in the French language. Its first resolution was to the effect that no change should be recommended in any of the decisions or actions of the preceding International Electrical Congresses in regard to Electrical or Magnetic Units. This was a unanimous vote. Among other questions, it effectually barred any consideration of the question of "rationalizing" the electromagnetic system of units according to the manner advocated by Heaviside. It left open for consideration any such decisions as would be in conformity with the resolutions of the preceding electrical congresses.

The next matter considered was the resolution of the American Institute of Electrical Engineers at its meeting of May, 1900. This resolution had been translated into the French language, and was placed before the members of the committee in printed form. The substance of this resolution was a report from the committee of the A. I. E. E. on Units and Standards, to the effect (1) that names were needed for the c. g. s. electrical units as also prefixes for additional decimal multiples and

A. E. KENNELLY.

S. P. THOMPSON.

sub-multiples; also (2) that the International Electrical Congress at Paris should be requested to select such names and prefixes, as well as to consider the means by which the rationalization of electromagnetic units might be effected

There was a strong sentiment among the European committee members to refrain from creating new names for units in general and c. g. s. units in particular. It was even the opinion of a few that the joule and the coulomb were in such small extent of use as to be a burden rather than a benefit. The session ended for the day without coming to any decision.

At the next session of the committee—Wednesday, Aug. 22—the questions at issue narrowed down to the consideration of names for magnetic units. On the one hand was the fact that in the United States the names gilbert, oersted, weber and gauss for magnetic units provisionally adopted by the A. I. E. E., had come into fairly extended although not universal use. On the other hand, these were c. g. s. units and not units in the practical system to which preceding congresses had given names. Moreover, the British Association had adopted certain other names for magnetic units partly in the c. g. s. and partly in the practical system, although these names had confessedly not entered practical use to any appreciable extent.

It was pointed out, however, that electrical instruments were now on the market which measured magnetic field intensities in c. g. s. units. In view of this fact, the committee decided to recommend the adoption of the name "gauss" for the c. g. s. unit of magnetic intensity in accordance with the name already provisionally adopted by the A. I. E. E. for that unit.

The next question was whether a unit of magnetic flux should be named. Opinions on this matter were very divergent. On the one hand, to adopt the gauss for c. g. s. magnetic intensity and some other name such as the weber for the practical unit of magnetic flux, i. e., 100 million c. g. s. lines, was somewhat an incoherent plan. On the other hand, there were strenuous claims advanced for the use of a practical unit which should remove the eighth power of 10 from the electromotive force formula of dynamo-electric machinery. There also seemed to be an objection to selecting two German names, especially as it was claimed that Weber had not worked in the direction of the investigation or development of magnetic fluxes. Finally it was agreed to recommend the name "maxwell" for the unit of magnetic flux, leaving its magnitude, however, to be assigned at some future date. In other words, no decision could be arrived at as to whether the unit of magnetic flux of the maxwell should be a practical unit of 10^{-8} c. g. s. lines, or whether it should be the c. g. s. unit itself.

Both these decisions were embraced in the form of a single resolution, which was voted for unanimously, with the exception of the delegate from Great Britain, who refrained from giving a vote on the ground that he was unable to ascertain either the opinions of his colleagues, or the precise resolutions of the British Association on the matter at this session. No action was taken either upon the matter of decimal prefixes or upon the Fessenden proposals for rationalization. No concurrence seemed attainable. The report of the committee was submitted to the International Congress on Friday, Aug. 24.

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When the report of the committee was laid before Section 1, that section amended the resolution by giving the name "maxwell" to the c. g. s. unit of magnetic flux, or as a substitute for the "weber" provisionally adopted by the A. I. E. E. The report was finally submitted to the official delegates from the various countries. At first they were in favor of taking no action in the matter and of leaving it to be voted upon by the whole congress of more than 1000 members. Owing mainly to the arguments of the American delegates, well set forth by Mr. Mailloux, the delegates finally voted to adopt the resolution of Section 1.

ELECTRIC LIGHTING SECTION.

The president of this section, Mr. Hippolyte Fontaine, called the meeting to order. For vice-presidents there were elected: Mr. Carl Hering (United States); Mr. Ferdinand Meyer (France), and Mr. de Fodor (Hungary). The secretaries were Messrs. Garnier, Pernollet and Soulier.

The first paper presented was by Mr. Blondel on "Progress in Electric Lamps," the greater part of which was read by Mr. Laporte in the author's absence.

P. JANET.

The president, in thanking Mr. Laporte, said that he did not quite understand why it should be desirable to return to clock movement for lamps, and mentioned the Gramme motor lamps of twenty years ago, which still worked well even in foundries, notwithstanding the dust, on account of the power of the motor.

Mr. C. O. Mailloux, speaking of clock lamps, said that they had disappeared in America, being too complicated, and simplicity in action was especially sought. In the United States higher tensions are used than in France, where it is generally about 100 volts, while at home a commencement was made with 70 volts, and it has now risen to 120 or 125 volts. A high voltage cuts down the line cost; the voltage of the machines may be about 125 volts, and 5 or 10 volts lost on the line; 220-volt lamps, he believed, had not a great future, being inferior to lower voltage lamps in length of life and in efficiency, while the lighting was not so satisfactory to the eyes. Mr. Blondel had spoken of the lack of efficiency in the Hartford installation, where alternating arc lamps were used with constant current transformers similar to those introduced by Ferranti. Mr. Mailloux contended that these lamps were both practical and good, and the efficiency of the system was high. The ordinary continuous current system would give an efficiency of about 75 per cent, but in the Hartford case it was greater.

Mr. de Fodor said that the arc light must be able to rival the Auer; that a fixity of light was required, with a perfect mechanism to insure it. Some tests which he had made with enclosd arcs had shown considerable want of stability. One of the chief requirements was a good mechanism, because the maintenance of that part of the lamp was the greatest trouble.

Mr. Mailloux said that good mechanisms were made in America. With respect to grouping of lamps, a high tension was required in light and power systems, so that lamps were placed in series. Lamps with long arcs had been tried, and worked well, using perhaps 3 amperes, but the light was violet colored and the efficiency was not sufficiently high. Lamps for 125 volts were made which would compare favorably with the Auer (Welsbach) burner.

Mr. Meyer believed there was a tendency to increase line voltage from 110 to 220 volts, and would like to know how such a change could be made on an existing system.

Mr. Fontaine said the consumer gained nothing by such a change, unless the company were to make substantial reduction in their charges.

Mr. de Fodor thought the only resouce was to reconstruct the system for the higher voltage.

The meeting was adjourned until Tuesday.

TUESDAY, AUG. 21.—The meeting was called to order by the president, Mr. Hippolyte Fontaine. After the minutes of the preceding session had been read and approved, the president remarked that motor lamps, referred to in the report, had not been abandoned by manufacturers, as they presented certain advantages on account of the power of the motor.

Mr. de Fodor read a paper on a "Proposed new method of charging for electric current." The author is manager of a Buda Pesth lighting station, and suggests that the best way to secure and retain

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customers is to allow them a considerable discount over and above the energy furnished beyond a certain limit, and that this discount should vary according to the season of the year, being greatest in the summer months and least in the winter months.

Mr. Lauriol said that such a system had been adopted in the Halles municipal station, Paris, the customer paying a fixed amount, and in addition thereto a sum proportional to the current used. With Mr. de Fodor's system, the station must know what the customer is doing, lest incorrect statements are handed in. Besides, there would be no advantage to the customer in having efficient lamps. Wright's demand system was capable of good results, but he thought the double meter the best arrangement, there being two dials of different gear, one used at one time of day, the other engaged the rest of the day. By this method a lower price could be charged when the load on the station was light.

Mr. de Fodor replied that he had used such a system—an Aron meter with a resistance introduced into the fine wire winding. Wright's meter system necessitated frequent visits to the customers, and was not altogether correct. He said that with his own system there was more inducement to use electric light than gas in the summer time, and the rivalry of gas was an important matter.

The president called attention to the fact that Mr. de Fodor's observations referred more particularly to Austria-Hungary, where gas was much used in connection with the Auer burner.

Mr. Lauriol said that Mr. de Fodor's system could be applied only where the company was free to make its own prices. In Buda Pesth gas was 20 centimes (4 cents) per cubic metre ($1.13 per thousand cubic feet), and electricity was 80 centimes (16 cents) per kw-hour, with a maximum discount of 60 per cent.

Mr. Meyer was of the opinion that electric energy should be charged for according to the nature of the installation—whether a private house, or restaurant, or store, etc.

The president, speaking in favor of Mr. de Fodor's proposed system, said that one of the advantages was that the high discount in summer would bring people to appreciate the many advantages of electric light, and lead to extensions of the service.

Mr. Claude believed that the amount charged should vary, not only with the season, but also with the time of day in order to more completely equalize the station output.

A paper was read by Mr. Mornat on the subject of "Electric Light and Motive Power in Theatres," which dealt principally with causes of fire, such as loose contacts, reduction of cross-section of leads due to electrolytic action, and faults of insulation. Several measures of safeguarding the buildings were suggested, but these are fully covered in the fire underwriters' specifications in the United States, while in France the restrictive measures are fewer.

Mr. Claude, in an interjected remark, referring to arc lighting, said that alternating current lamps were very satisfactory in most ways, but their self-induction caused them to regulate poorly. If, however, a suitable condenser were included in the circuit the self-induction could be neutralized, and greater sensitiveness secured in the regulation.

The meeting was adjourned to Wednesday, Aug. 22.

WEDNESDAY, AUG. 22.—Mr. Hippolyte Fontaine called the meeting to order. After the minutes of the preceding session had been read and approved, a paper was read by Mr. Weissmann on "Low Voltage Lamps with Heavy Filaments." The discussion was deferred until the paper should be printed and distributed.

Discussion was recommenced by Mr. Bochet on Mr. Blondel's paper on arc lighting. He found that lamps with a good mechanism for regulating the arc gave the same results as differential lamps, and the only important question was a proper choice of carbons. With regard to the Claude lamp, this presented decided advantages, as a brake was pressed down on the periphery of the feed wheel, and the regulating magnet core did not change its position relative to the solenoid, only varying in the weight or amount of pull applied to the brake-shoe, so that the self-induction of the solenoid remained constant. Mr. Bochet believed that high voltages in electric systems would prove best, because supply of power demanded it. With 220-volt lamps a three-wire system of 440 volts across the outer leads could be used, from which a satisfactory motor service could be given.

Prof. Ayrton spoke of Langhaus' experiments, as cited by Mr. Blondel, which were undertaken with a view of improving the efficiency of incandescent lamps. The construction of the filaments involved many difficulties. In some experiments which he had undertaken with these lamps, in which a filament chiefly composed of carbide of silicon was used, he obtained some very high efficiencies, although he was not yet able to speak as to length of life of these lamps. In a set of 100-volt lamps he obtained the following results:

Current in amperes.	Candle-power.	Efficiency.
.32	18.8	1.73 watts per candle.
.72	50.	1.44 watts per candle.
.81	72.	1.13 watts per candle.

Mr. C. O. Mailloux said that in America alternating current arc lamps in series were much used. The power factor was, however, an important matter, so that the reaction of the series coil must be cut down. With regard to incandescent circuits there were the fuses to consider in adopting high tensions. When a fuse melted on a 100-volt circuit, it was not nearly so serious a matter as when that occurred on a 200 or 250-volt circuit, for the effect was not a direct function of the e. m. f. The insurance regulations in France were very flexible and allowed almost anything to be put in, but in America the regulations were exceedingly severe, and specified rigidly every detail. When a station supplies current for power purposes chiefly it would be well to use a high tension; but for incandescent lighting a low tension was preferable.

Mr. de Fodor said that a 220-volt system was inconvenient for arc lighting, as it was necessary to put lamps four in series, and many small stores would need but one lamp.

Prof. S. P. Thompson said that 220-volt lamps were being much used in England. The municipal stations used to be on a 100-volt system, but they were now being changed to 200 volts or even to 240 volts. He opposed this change because it was so much against the interest of the consumers, for the high tension lamps have a very poor efficiency, requiring 6, 7 or even 8 watts per candle, which was a serious matter for those who pay the bills. The life of the lamps also is short. There was a notable instance of a change from 100 to 200 volts, which came under his notice. It was at Westminster, where a private company was doing the lighting, and in their district was the headquarters of the Institution of Electrical Engineers, in Victoria Street. The company proposed to change from 100 volts to double that voltage, and in order to secure the consent of the customers they promised to give new lamps instead of the old ones and 8 per cent discount on the bills. It was a fact, said Prof. Thompson, that the only objection to the innovation came from the electrical engineers.

Mr. Mailloux observed that the efficiency of high tension lamps was rational at first, being 3.5 to 4 watts per candle, but the efficiency fell with use.

Mr. de Fodor found that high tension lamps would show an efficiency at first of 4 watts per candle, but at the end of 200 hours they gave no more light.

In reply to a question by Mr. Meyer, Mr. Mailloux explained the character of the inspection of installations required in America and the constitution of the National Board of Fire Underwriters. In Paris, he said, there were practically no restrictions on electrical installations, while in the United States every detail was minutely described, and it was necessary to carefully follow the specifications and secure proper inspection, or else no insurance could be placed upon the building. That, he said, was an effective method of securing a compliance with regulations, because no man could well afford to risk having a fire at his own expense. It was a serious enough matter even when insurance nominally covered the value. The meeting adjourned till Aug. 23.

THURSDAY, AUG. 23.—The meeting was called to order by Mr. Hippolyte Fontaine, and the minutes of the preceding session were read and approved. The president remarked that Prof. Ayrton had tendered to Mr. Blondel the congratulations of all electrical engineers on his valuable contributions to science.

Mrs. Ayrton read a paper on "The Luminous Intensity of the Continuous Current Arc." The president thanked Mrs. Ayrton for her very interesting communication, which brought before them some entirely new ideas.

Mr. Bochet remarked that the reduced brightness of the crater with long arcs was supposed by Mr. Blondel to be due to the cooling of the arc in the air.

Prof. Ayrton indicated the lines of research pursued by himself which Mrs. Aryton had followed up independently, resulting in the brilliant work which she had just produced.

Mr. Arnoux said that an important point to be considered, from a practical point of view, was the stability of illumination, because in general these small gaps between carbons cause excrescences to form on the negative carbon, which affect the steadiness of the light and affect the eyes in a disagreeable manner.

Prof. S. P. Thompson remarked that Mrs. Ayrton had furnished an explanation of Trotter's phenomenon, which was that, when viewed through a turning disk, there appeared in the arc something turning. That must be the whirls of carbon dust which Mrs. Ayrton had mentioned. With regard to what was called the counter e. m. f. of the arc, this was supposed to be evident near the positive carbon. It was not known whether it was that or an inversely varying resistance. With an increase of current the density in the air layer increases and the resistance accordingly diminishes.

In reference to a note communicated by Messrs. Blondel and Gigouzo on luminous efficiency of alternating current arcs, Mr. W. Duddell showed that with an iron core armature the curve of the current passing through the arc approached the sine value, the generator giving a peaked curve. But with a Ferranti alternator having very low self-induction the current curve for the arc was of a peaked form and of lower luminous efficiency. When, however, a transformer was introduced, its self-induction forced current through the arc, so that a very good curve was obtained and high efficiency.

Mr. Arnoux said that in extending also to alternating current arcs the law of the critical gap, the researches of Messrs. Blondel and Gigouzo completed in a remarkable manner Mrs. Ayrton's investigations. With regard to the periodic extinction of the arc referred to in their communication, he did not consider it necessary that the form of e. m. f. curve should approximate a rectangular form, because a high potential was not necessary for the continual re-establishment of an arc. Experiments which he had undertaken showed that a lighthouse arc carrying 250 amperes would relight spontaneously through a gap of 2 mm a quarter of a minute after extinction.

Discussing Mr. de Fodor's paper on the proposed new method of charging for electric current, Mr. Pellissier spoke of a differential tariff which was analogous to that proposed by him, but based on the number of lamps alight at one time, and not on those actually installed.

Mr. Lutoslawski described a system adopted at Warsaw in which the customers were charged according to a predetermined maximum value of current, the actual number of kw-hours used per year according to the meter being divided by this maximum. As a safeguard against the use of a load greater than the declared maximum, an automatic time limit circuit breaker was proposed, which would cut out the lamps if the maximum current value was passed for a period longer than half an hour.

Mr. Victor spoke of a system of control using a recording instrument to indicate when the load on an individual circuit was higher than the maximum.

Mr. de Fodor based his charges on an average of 440 hours per lamp per annum, a figure which was the result of careful statistics. The use of a circuit breaker on a private installation would lead to discouraging the customer, while Mr. Victor's system required a special apparatus.

Mr. Victor said that central stations would be favorable to the use of a controlling instrument; besides, the apparatus would not operate unless the client were trying to cheat the company.

Mr. Pellissier believed that controlling instruments were becoming much used in Europe, and they presented a considerable advantage.

NOTES.

MR. J. G. WHITE gave a dinner on Sunday evening, Aug. 19, at the Restaurant d'Armenonville, Bois de Boulogne, to the members of the committee of arrangements of the British Institution of Electrical Engineers and the American Institute of Electrical Engineers.

CONGRESS FESTIVITIES.—Among the more formal dinners given during the congress to prominent attendants were the following: Monday evening, Aug. 20, a dinner by Prof. Janet, secretary of the congress. Wednesday evening, a dinner by Sir William H. Preece. Thursday evening, a dinner by Mr. C. O. Mailloux. Saturday evening, a dinner by Prof. Mascart. Sunday evening, a dinner by Prof. Hospitalier. On Friday afternoon German members of the congress entertained their foreign colleagues at a reception given in the German National Pavilion. On Wednesday Mr. Carl Hering gave a luncheon to the more prominent officers of the congress.

The German Atlantic Cable.

The new transatlantic cable, laid this year between New York and Emden, Germany, was opened for the reception of public business Sept. 1. The cable touches at the Azores Islands, and connects at Emden directly with the German telegraph lines.

International Physical Congress.

(From Our Special Correspondent.)

Without doubt the most interesting paper presented before the Physical Congress just closed at Paris was that of Prof. H. Poincaré "On the Relations Between Experimental and Mathematical Physics." This title characterizes rather vaguely the contents of the paper, which is rather a broad discussion of the methods of scientific generalization and the limitations of physical science, and as such takes rank with the work of Newton and Descartes.

Starting out with the statement that experiment is the only source of truth, that through it alone can we learn new things and through it alone obtain certainty, the question is asked, What place does there then remain for mathematical physics? The answer is that to use experimental facts generalization is necessary. Science is made up of facts as a house is of stones; but an accumulation of facts is no more a science than a pile of stones is a house. Science is compared with a library which should grow unceasingly, but possessed of an insufficient fund for purchases which the librarian should apply with judgment. Experimental physics alone can enrich the library, and to mathematical physics falls the task of cataloguing. If the catalogue is well prepared, the library is no richer, but readers will be better able to avail themselves of its riches. Moreover, by indicating to the librarian deficiencies, he is enabled to apply his fund to better advantage—which is the more important from its insufficiency. The role of mathematical physics is thus to guide generalization in such a manner as to increase the efficiency of science. The manner in which this may be done is discussed under the heads of the unity of nature, the role of hypotheses, the origin of mathematical physics, the signification of physical theories, physics and mechanical conceptions, and the present state of science.

Most frequently a law is considered simple until the contrary is proved. On the other hand, discoveries bring forth daily new details, richer and more complete. If we study the history of science we find that at times simplicity is concealed under complex appearances, and at times apparent simplicity dissimulates extreme complexity. For example, the law of Mariotti relates to a phenomenon, each individual element of which is complicated, while the law of great numbers establishes simplicity in the mean—simplicity being thus only apparent, the crudeness of our senses concealing the actual complexity. As our means of investigation become more and more powerful, we shall discern the simple under the complex, then the complex under the simple, then again the simple under the complex, and so on without being able to see the final term. It is necessary to stop somewhere, and for science to be possible, this must be when simplicity is found. This is the only foundation upon which can be raised the structure of our generalizations. For what does it matter if the simplicity is real or that it covers complexity? Whether due to large numbers which level individual differences, or the largeness or smallness of certain quantities which permit certain terms to be neglected, in every case it is not to chance—simplicity, real or apparent, has always a cause. We can therefore always reason that if a simple law has been observed in several specific cases, we may legitimately assume that it will be true in analogous cases.

Every generalization is a hypothesis, and hypotheses have therefore a necessary role which no one has ever contested, but care should be taken to distinguish between the different kinds. There are first axiomatic hypotheses, such as that the influence of a body at a great distance can be neglected, that an effect is continuous function of a cause, that symmetry may be assumed, etc. This class forms the common stock of all the theories of mathematical physics. A second class may be denominated as indifferent hypotheses, such as the atomic constitution of matter, for if experiment confirms the conclusions established thereon, the real existence of atoms is not implied. This class of hypotheses is never dangerous if their character is not lost sight of. Finally, a third class of hypotheses consists of true generalization, which experiment will confirm or destroy.

The section on the origin of mathematical physics goes into the minutiae of methods of generalization, one of the conclusions being that mathematical physics owes its being to the approximate homogeneity of the matter studied by physicists—natural science lacking this condition as well as that of the relative independence of distant parts and simplicity of elementary facts.

Referring to the ephemeral nature of many scientific theories, the remark is made that the ruins may yet contain something of good. If through theories relations are established which hold good, the

theory has served a good end, though shown to be untenable. The relations are the only reality, and it matters not if they are replaced by one image or by another. A dead theory may again come to life if it expresses true relations, and a recent example of such a resurrection is the electric molecule theory of Coulomb, which conception reappears in the guise of electrified ions. Again, the theory of Carnot, though based on the false conception of caloric, contains the fundamental relations of modern thermodynamics.

Prof. Poincaré betrays some impatience with the predilection of many physicists for explanations borrowed from mechanics and dynamics, such as the motions and shocks of molecular matter and articulated molecules; and also for the overworking of the ether. Such choices, if not apt to affirm false relations, may tend to conceal true ones.

After reviewing the recent advances of science, and treating at length the theory of Lorentz with its contradiction of Newton's law, Prof. Poincaré concludes that we have advanced toward unity. The relations which we had recognized between bodies which we believed simple still subsist, though we now recognize the bodies to be complex, and that is all that counts. Our equations become more and more complicated, it is true, but their form has persisted. Moreover, the methods of physics have invaded the domain of chemistry, and though physical chemistry is young it has already enabled us to connect among them such phenomena as electrolysis, osmose, the movements of ions.

One of the important communcations to the congress was a paper by Prof. Branly on "Radioconductors," which term the author prefers to "coherers" for reasons advanced in the paper. The contribution forms, in fact, a complete treatise on the Branly tube, or coherer. A paragraph in the paper considers the question of priority, which Branly claims for himself. The rather absurd claims put forward by Lodge for Guitard (1850) and Rayleigh (1879) are dismissed with the remark that the discovery by Varley of the decrease of resistance of carbon with increase of e. m. f. is logically more cognate. On the other hand, the researches of Prof. Onesti (1885) do not appear to be given the consideration they deserve.

The treatment is in the form of citations from early papers by the author, and with additions brings the various subjects to date. As to the effect of the magnitude of the e. m. f. in circuit with the coherer, it is shown that, independent of the resistance in circuit, the conductibility of a coherer increases for most materials with the e. m. f. Concerning the effect of metallically screening the tube, it is stated that if hermetically sealed with a metal envelope, no action occurs, however thin the metal. Damp cement, and conductive liquids, particularly sea water, intercept all effect if interposed with a thickness of a few centimetres. In the case of solid coherers (spheres and disks) heat has the same effect as a shock in restoring the resistance.

Referring to researches for the best metal to use in a tube, Prof. Branly says that the same metal will act quite differently under different circumstances. To make comparisons care should be taken that the filings are sifted, and their age enters as a factor. In addition, the section of the tube, the diameter of the particles and their disposition in the tube should have a relation with the conductibility of the metal, while the e. m. f. is also an important factor. Through having neglected these precautions, some experimenters have recommended certain materials as superior to others, such as oxidizable metals, with the statement that a very thin layer of oxide or sulphur is indispensable. Branly considers that this distinction is unfounded, and that the layer of oxide and sulphur does not constitute an essential factor.

To encourage those hesitating to make the attempt, Prof. Branly adds that the adjustment of a coherer presents no difficulty. Between two metal electrodes fitting in a glass tube are introduced metal filings sifted through a screen of 180 or 200. By slight movements the distance between the electrodes is changed until there is shown by means of a galvanometer and battery in circuit a large resistance. The electrodes should be threaded for adjustment.

As to forms of coherers, Prof. Branly has used columns of steel and aluminum spheres from ⅛ to 2 ins. in diameter, which are as sensitive as the best tube of filings, and the same is true of 1½-in. disks of iron, steel and aluminum. In the case of spheres, the nature of the metal plays a role. In one class are zinc, copper, brass, silver, etc., and in another iron, steel, aluminum, bismuth, lead, tin, etc. In the case of the first group there is no appreciable contact resistance, while in the second case the reverse is true, and if two different metals of the second group are used, the contact resistance is higher than if the same metal were used. Prof. Branly adds that if metals of the second group had been first used in electrical measurements, the search for the laws of the electric current would have been much more difficult and their discovery perhaps much retarded.

Prof. Branly rejects the Lodge theory that the action of the Branly tube is due to coherence and decoherence of the filings contained, and for this reason prefers the term "radioconductor" to "coherer." A number of objections are given to the Lodge theory which appear difficult to overcome. In turn the theory is offered that it can be accepted that it is not necessary for the particles of a conductor to be in contact to deliver passage to even a feeble electrical current; the distance through which persistent conductibility may be established depends upon the radius of activity, which is considerably augmented by the energy of anterior electrical effects—in this case the insulation serving principally to maintain a certain interval between the particles.

Certain forms of coherers with a single contact are described, such as two crossed oxidized rods of copper or steel, or a steel point resting on a steel surface, or an aluminum point on a bismuth surface.

A paper contributed by Ch. Ed. Guillaume, physicist of the International Bureau of Weights and Measures, "On Units of Measurement," and intended to serve as a basis for discussion, gives a historical résumé of the subject and an account of propositions offered, involving changes or extensions. For the unit of emissivity the following definition is offered: "The coefficient which, multiplied by the surface of the radiating body in square centimetres, and by the fourth power of the absolute temperature in thousandths of degrees, will give in watts the rate of emission." As an example, for a black body of one square cm surface and 1500 degs. C. radiating into a black surrounding at 0 degs., the rate of emission would be $5.32\ (1.773^4 - .273^4) = 52.5$ watts. The coefficient is thus 5.32. The Violle photometric standard, consisting of a surface of melted platinum, is stated to have upheld its superiority, but its definition should be completed by specifying that the surface of the platinum be shielded from the influence of all reflecting or radiating surfaces. The abuse of the term *force* is referred to, and its suppression advised in the expressions "electrical or magnetic force" where a field of force is implied. It is recommended that square centimetre, cubic millimetre, etc., be written cm^2, mm^3, etc. A unit of pressure is proposed, to be called the "barye," and corresponding to the pressure exerted by a column of mercury 75 cm long. The normal intensity of weight is defined by the condition that this unit is equal to one megadyne per cm^2. It is recommended that the unit of radiation be related to the c. g. s. system and expressed in watts per cm^2; that diagrams employed to represent the distribution of energy in the spectrum be based on wave lengths and the logarithmic scale employed from the ultra violet to electric radiations; and that the spectrum be divided into zones analogous to acoustic octaves, the zone Z_0 corresponding to the visible zone and the successive zones having negative subscripts toward ultra violet and positive subscripts toward the infra red.

Prof. Lucien Poincaré of the Sorbonne read a paper entitled "Some Remarks on the Theories of the Voltaic Cell," in which, among others, are considered the subjects of the origin of the energy and the seat of e. m. f. of a cell. The author states that to Prof. Willard Gibbs the immortal honor is due of having extended the principles of thermodynamics to chemical and electrochemical phenomena, and thus led to a true understanding of the action of the voltaic cell. Thermodynamics teach us the origin of e. m. f., and hypotheses such as those of Arrhenius and Nernst give a conception of the mechanism by which e. m. f. is produced. As to the seat, the e. m. f. of a cell is probably equal to the sum of differences of potential at the various contacts. The author discusses the theories of Nernst at length and refers to the papers presented to the congress by Profs. Christiansen and Arrhenius for a fuller development of the modern theories of the voltaic cell. The first mentioned is entitled "On Contact Electricity," and deals with experimental methods, results and theories. The conclusion is that, though the question of the origin of the difference of potential of contact has been discussed for a century, we do not know much concerning its nature, probably owing to the limitation of our knowledge concerning the constitution of bodies and their interior movements. The researches of Nernst constitute an exception, but are not yet open for unqualified acceptance. The paper by Arrhenius, entitled "Electrolytic Dissociation" gives a historical résumé of the subject and an examination into its various details. In conclusion it is stated that the theory of electrolytic dissociation has confirmed the Van t'Hoff theory of solutions, created a rational foundation for analytical chemistry,

cleared up the catalytic chemical actions, permitted the quantitative calculation of the phenomena of neutralization and hydrolyse, and has furnished a mechanical representation of the manner in which e. m. f. is produced. It has also given important explanations of difficult questions in physiology, hydrography and geology, and promises to bring about great progress in these branches of science.

Prof. Carl Barus, of Brown University, presented a report on the progress of pyrometry, in which he considers the subject under the heads of solids and liquids, gases, optical methods and electrical methods. Referring to the measurement of temperature by the electrical resistance method, it is stated that for a certain interval of temperature no other type of pyrometer can approach it in sensitiveness as constructed to-day. For the generality of applications, however, it is inferior to the thermo-couple of LeChatelier, and particularly for high temperatures. As to thermo-couples, Prof. Barus pronounces strongly in favor of platinum-iridium. The conclusions of the report are that the present state of pyrometry is most encouraging. In Germany the Reichanstalt has constructed a gas thermometer of remarkable accuracy from absolute zero to 1000 C. In France LeChatelier has perfected practical pyrometry and Berthelot has devised an optical method for the measurement of temperature in absolute values and without superior limit other than that fixed by the difficulty in manufacturing apparatus of refractory material; and the discovery of Nernst that the earth metals become conductive at high temperatures makes it possible to heat electrically the most infusible matters to the highest point.

In a paper presented by Prof. Aimé Witz of the University of Lille, the progress of the theory of the heat engine is sketched. The author inclines strongly toward the school of Hirn as opposed to that of Clausius, and Dwelshauvers-Dery is much quoted as the exponent of the former. The eutropy diagram is viewed with much favor, this diagram having the property of representing by its area the quantities of heat taken from the source and passed to the condenser; the difference is the heat transformed into work, and the efficiency can be determined by the planimeter, while the curves of an indicator diagram enable those of the eutropy diagram to be correctly constructed. The mathematical theory of the steam engine as founded by Grashof and Kirsch and developed by Nadal is referred to as an important progress. The latter has laid down a method whereby the theory of the propagation of heat between a vapor, the temperature of which varies with the time, and a cylinder wall, though covered with a liquid layer, may be established to a high degree of correctness. Nadal has also given a general formula for efficiency in which the numerator is the work indicated and the denominator the total heat admitted to the cylinder; but the latter quantity is subdivided into three parts, consisting of sensible heat, heat expended in cylinder condensation and heat lost through leakage. The final formula permits to be calculated the distribution of heat in large engines and the solution of problems affecting the construction and operation of steam engines.

The theory of the gas engine is referred to as being far behind that of the steam engine, and it is suggested that the eutropy diagram be applied, which method will permit the exact determination of the quantities of heat exchanged between the gas and the cylinder walls and those carried off in the exhaust.

Prof. E. Bouty of the Sorbonne, in a paper entitled "The Gases Considered as Dielectrics," gave a résumé of the subject from the time of Faraday to date. The different methods for the measurement of the specific inductive capacity are sketched, and it is shown that the law of Maxwell connecting specific inductive capacity with the index of refraction does not hold for certain vapors. The liquids corresponding to these vapors are dielectrics more or less conductive, and give numbers much superior to the square of the index of the liquid; it can therefore be concluded that when the law of Maxwell does not apply in the case of a liquid, it will not apply to the vapor of that liquid.

In determining dielectric strength by sparking, the distance between electrodes is modified by the presence of dust, permanent and temporary modifications of the surface of electrodes, the action of ultra-violet light and the material of the electrodes. Most of the disturbing influences would be absent if the electrodes could be suppressed. Prof. Bouty describes a method by which the point of conductivity of a gas at a given pressure may be simply determined, which consists in interposing the gas between the plates of a condenser, the capacity of which augments when the gas becomes conductive. Using this method he has found that in feeble fields a rarefied gas at any pressure does not show the least trace of conductivity; that for each pressure there is a limiting value of a field at which the gas acts as a conductor; and that when a gas becomes conductive it gives forth light, both at the charge and discharge of the condenser. Prof. Bouty proposes the term "dielectric cohesion" for use in connection with the limiting value of field above referred to, reserving the name "dielectric strength" to designate the minimum sparking distance between electrodes. Thus, the dielectric cohesion is the minimum field at which a gas becomes capable of giving passage to electricity. It is a linear function of the pressure down to a certain point, and for feeble pressures varies inversely as the square of the pressure. Prof. Bouty concludes his paper with the remark that our present knowledge of dielectrics is so little advanced, and that we are far from possessing the data necessary to penetrate the mechanism of the phenomena involved—a remark strongly corroborated by the very recent discovery that a gas at the smallest possible pressure permits a charge to pass if the cathode is subjected to the influence of ultra-violet rays.

In a paper on "National Physico-Technical Laboratories" Prof. H. Pellat of the Sorbonne gave an account of the several European national laboratories for the verification of instruments of precision, the supply of standards, the conduct of original research, etc. Naturally, first in order of treatment comes the Physikalische Technische Reichanstalt, of Charlottenburg, Germany, the director of which has under his orders a personnel of 80 employees. The Reichanstalt is divided into two sections, the first being devoted to questions of more purely scientific interest, and the second to calibration, standardization and the determination of physical quantities having a less scientific character than those dealt with in the first section. The latter section is subdivided into six sub-sections, one of which takes cognizance of mechanical, and another of electrical subjects.

England possesses three standardizing laboratories, and a fourth is in process of organization which will be constituted with the Reichanstalt as a model and known as the National Physical Laboratory. Of the present national laboratories, one has charge of the standards of measures of length, weight, etc., and of comparisons of the same. Another is the Board of Trade Electrical Standardizing Laboratory, and the third the Kew Laboratory, which, besides its meteorological work, standardizes thermometers, barometers, surveying apparatus, sextants, chronometers, photographic lenses, etc.

Russia possesses in its Central Bureau of Weights and Measures a number of large and admirably equipped laboratories, one of which is devoted to the verification of all instruments used in electrical measurement. The budget is $44,600 per annum, and there are fourteen principal employees. Russia has, in addition, a standardizing laboratory for the verification of measures and instruments used in the customs, excise and other government departments; and a third laboratory for the verification of meteorological instruments.

In Austria there is a government laboratory similar to the one at Charlottenburg, one department of which is devoted to electrical standards.

Prof. Pellat refers to the university and college laboratories of the United States as splendidly organized, and mistakenly says that they do the listing and standardizing necessary in the industries and sciences of the country. Though France has no national laboratory of the kind to which the paper refers, it is yet better off than the United States, so far as electrical standardization is concerned, through the facilities offered by the testing and standardizing laboratory conducted under the auspices of the French professional electrical body, the Société Internationale des Electriciens. At the conclusion of Prof. Pellat's paper a resolution was unanimously adopted urging that, in view of their great value to science and the arts, countries not now provided with national physico-technical laboratories should provide for the same.

"Uranium Rays" form the subject of a paper by Prof. Henri Becquerel. The first publication is credited to M. Niewenglowski in 1896, the author following seven days later with an account of his work. All the researches to date are reviewed and the conclusion arrived at that they show the existence of bodies which emit spontaneously radiations capable of traversing bodies opaque to light, and which radiations reduce the salts of silver, produce diverse chemical actions and render gases conductive by ionization. One part of the radiations is affected by a magnetic field, as in the case of cathode rays, and another is not thus affected. It is not known if

these two parts are simultaneous or independent, or if one of them gives rise to the other in the manner that cathode rays give rise to Röntgen rays and the latter to secondary deviable rays. The spontaneity of radiation does not necessarily imply any contradiction of the law of the conservation of energy, since the energy is so small as to be comparable to that of the evaporation of certain odorant matter. In a paper entitled "New Radio-active Substances and the Rays they Emit," M. and Mme. Curie give the name "radio-actives" to the substances which emit Becquerel rays. A method is given which permits of the accurate measurement of radio-activity, and figures are given for eleven uranic compounds. Black oxide of uranium was found more active than the metal base. The authors suggest that Becquerel rays are a secondary emission due to rays analogous to Röntgen rays traversing all space and all bodies.

"Cathode Rays" formed the subject of a paper by Dr. M. Villard, in which, after recapitulating the properties of cathode rays, a mathematical treatment of the subject is given. The authors accept the hypothesis that the cathode discharges are material, and conclude that while awaiting the discovery of a gas corresponding to the extremely small electro-chemical equivalent indicated (1000 times smaller than hydrogen), an acceptable hypothesis is that hydrogen constitutes the radiant matter.

Prof. E. Warburg, of Berlin, presented a paper "On Hysteresis," in which the subject is treated comprehensively though concisely. Following a historical résumé is a section showing that the correctness has been established of Lord Rayleigh's statement that there is no hysteresis for very small values of field. The next section deduces an analytical expression for weak fields, and in the following one an approximate expression is given for strong fields. The author devotes a section to hysteretic constants, and in referring to the expression proposed by Steinmetz for calculating hysteretic loss, it is stated that it gives values differing as high as 40 per cent from observed values.

Prof. Franz Exner of the University of Vienna presented a paper in which a résumé is given of recent researches relative to atmospheric electricity. Prof. Exner's theory of atmospheric electricity is that the earth alone possesses a negative charge, of which one part, carried off by vapor, spreads out in the atmosphere and returns in rain drops. M. Brillouin has offered a theory founded on the action of ultra-violet light on ice. Needles of ice in cirrus clouds are electrified, positive at one end and negative at the other; under the action of solar rays the negative discharge is dissipated in the air, and we have on the one hand negative air, and on the other positive clouds. M. Braun has suggested a theory based upon the dependence of a field on the temperature, the deduction being that a high temperature corresponds to a weak field. Finally, Elster and Geitel have proposed a theory based on ions according to which the air retains an excess of positive ions.

Prof. Bichat of the University of Nancy and M. Swyngedauw of the University of Lille, in their paper entitled "Actino-Electric Phenomena Produced by Violet Rays," give a résumé of the authoritative literature to date on the subject. In view of the recent discovery of Lenard that through the influence on the cathode of ultra-violet rays an electrical discharge may be sent through a perfect vacuum, it is suggested that the phenomena of disrupted discharge and the loss of charge through the influence of the rays may be correlative, and certain absorption experiments confirm this view. However this may be, the discovery of Lenard has shown that loss of charge is promoted by one particular form of disruptive discharge—the emission of cathode rays.

Prof. H. DuBois, of Berlin, in a paper entitled "Magnetic Properties of Ponderable Matter," examines the magnetic phenomena of ferromagnetic, paramagnetic and diamagnetic bodies in the light of knowledge accumulated to date. The paper has the form of a treatise limited to the consideration of the effect of a field of force on bodies subject to magnetic influence and excluding hysteresis. Many numerical data are given, and particularly for substances, merely mentioned in usual treatises or ignored entirely.

Prof. H. Nagaoka of the University of Tokyo presented a paper entitled "On Magneto-Striction" dealing with the deformations observed in ferro-magnetic bodies when subjected to magnetic influence. Curves and numerical data are given, and the conclusion arrived at that the theory of magneto-striction is yet in its infancy. A paper entitled "Physical Modifications Due to Magnetization," by Prof. Hurmuzescu, treats also of magneto-striction in a general consideration indicated by the title. Among the conclusions are that bodies when magnetized are less attackable by acids than when in a neutral state; that in a system magnetized body—acid-neutral body, the latter is transported to the former; that an electrolytic deposit is most abundant on the most highly magnetized portion of a body. Diamagnetic bodies present inverse properties.

In a paper on "The Aurora Borealis," M. Paulsen gives the methods and results of observations by a Danish party in Iceland, and deductions therefrom. The effect of the aurora borealis on the earth's field was found to be relatively small, and most marked in the case of movable auroras, the spectra of which present many lines.

Prof. von Lang, of Vienna, in a paper entitled "Counter E. M. F. of the Voltaic Arc," sets forth the various theories offered to account for the apparent counter e. m. f. existing in the voltaic arc, based respectively upon thermal effect, vaporization, chemical reaction, ionization of electrodes and rapid successive electrical discharges. The conclusion is that vaporization is the most probable cause.

"The Electro-Chemical Equivalent of Silver" forms the title of a paper by Prof. Leduc, of Paris, in which it is shown that this equivalent may pass the value of .01120, instead of the accepted value, .01118. The author strongly condemns the definition of the ampere in terms of silver deposited, owing to the large number of factors affecting such a determination.

In a paper "On the Mechanical Equivalent of Heat," Prof. Ames of Johns Hopkins University discusses the different methods for its determination and the different values arrived at. The value he accepts is 4.181×10^7 at 20 degs. C. For the heat of vaporization of water the value of Regnault is stated to be worthy of confidence, this value being at 99.88 degs. C. 536.67 calories, or $536.67 \times 4.183 \times 10^7$ ergs.

Prof. A. Abraham contributed a paper on the measurement of the ratio of the electrostatic and electromagnetic units, in which the different methods and results are discussed. The conclusion is that this ratio is capable of measurement with a precision superior to that attainable in the measurement of the velocity of light.

In a paper by Prof. Chappuis on "The Normal Thermometric Scale and the Practical Scale for the Measurement of Temperature," the results of researches are given, and certain conclusions noted. It is stated that to-day mercury thermometers of very high accuracy are obtainable for use up to 200 degs. C. The alcohol thermometer is going out of use on account of its inaccuracy, a liquid thermometer employing toluene being much more satisfactory. This liquid solidifies at 102 degs., and it has been proposed to replace it with a petroleum liquid which only solidifies at the temperature of liquid air. The use of platinum resistances for measuring low temperatures is subject to error on account of decreased resistivity which, by the usual resistance formula, becomes zero at 265 C.

Prof. A. Righi, of the University of Boulogne, in a paper on "Hertzian Waves," treats the subject under the heads of receivers and transmitters, coherers, aerial telegraphy and the optics of electrical oscillations. In addition to full historical references and a résumé of the more important work of others, the author gives an account of important recent work of his own hitherto undescribed.

In a paper, largely mathematical, "On the Theory of Magneto-Optical Phenomena," H. A. Lorentz examines the theories of Voigt, Larmor and others, and applies his own hypothesis to the Zeeman effect. The paper, which is not capable of condensation, is a valuable résumé of, and contribution to, the theory of ions—a theory which Poincaré pronounces one of the greatest of the age.

Prof. A. Blondel, in a paper entitled "Direct Records of Variable Currents," gives a description of several systems for obtaining records of variable electrical currents by the direct method. The systems described are those of Blondel, Abraham, and Hess-Braun. The author considers that the apparatus of this kind are better and simpler for industrial purposes than the apparatus of indirect methods.

In a paper entitled "Polyphase Currents," Prof. A. Potier gives an excellent résumé of the subject. The object of the paper is stated to be to define polyphase currents, to describe how they are generated and utilized, and for the benefit of physicists and not engineers. Details of construction and design are not treated, only the distinctive features of polyphase systems being brought out, and the application indicated of the general laws of electromagnetism and induction to particular cases considered.

Dynamotors versus Motor Generators.

BY ALTON D. ADAMS.

DYNAMOTORS, that is, electric machines with two independent armature windings and a single magnet frame each, are used for a number of cases in which electrical energy, available as either alternating or direct current at a certain pressure, must be transformed as to kind of current or changed as to pressure. They are used for the same kinds of service as are rotary transformers, and especially for some special cases where the former could not perform the required service. A motor generator consists essentially of two electric machines mechanically coupled, so that one machine, operating as a motor from a suitable source of energy, drives the other while it delivers current of the desired pressure and quality. Each electric machine that goes to make up a motor generator has its own magnet frame, coils and armature. The nature of the constructions in dynamotors and in motor generators gives each of these machines certain characteristics as to first cost, efficiency, operation and range of application that are inherent. A proper consideration of these qualities will show the kinds of service to which each of the two sorts of machines is the better adapted, but it is not infrequent to find a machine of one of these classes engaged on work for which the other could be substituted with advantage. Capacity in either the dynamotor or the motor dynamo, so far as the user is interested, is measured by the ability of one armature or armature winding to deliver the kind of electrical energy desired. In a dynamotor with two independent armature windings on a single core, the winding that absorbs electric energy to cause rotation must have a slightly greater capacity than the winding that delivers electrical energy, or else must heat more. The reason for this difference between the two armature windings arises from the fact that the energy absorbed by the motor coils must equal that delivered by the dynamo coils, plus that lost in the armature and bearings as friction, hysteresis and heat. Approximately, therefore, the capacity of a dynamotor is one-half the capacity its frame would have if provided with only one set of armature coils and driven by mechanical power at the same speed. Of the two independent machines, combined to make a motor generator, the dynamo may be of the smaller capacity by the sum of the losses in the armatures and bearings of both machines, but as this sum is not a large amount, it is not infrequent to find two machines of equal capacities coupled to form a motor dynamo.

In the matter of first cost, therefore, a dynamotor is made more expensive than a simple dynamo, of double the desired capacity, by the use of two commutators instead of one, the extension of the base and shaft at one end and the labor required to assemble the greater number of armature coils. These additions do not, usually, increase the cost of construction more than 25 per cent. For a motor generator, a dynamo frame, with one-half of the capacity of the frame of a rotary transformer for the same work, is necessary, and also a motor frame of a little more than the dynamo frame capacity. The comparative costs are, thus, that for a dynamo of twice the desired capacity with about 25 per cent added, and that for two dynamos, each of about the desired capacity. If a dynamotor is wanted to deliver 10 kilowatts, the frame of a 20-kw dynamo can be wound for the work, while if a motor dynamo of equal capacity is desired, two machines, each of not less than 10 kilowatts must be used. With quite small motors and dynamos, say from .5 to 20 kilowatts capacity, the cost increases less rapidly than the rated output, but for larger sizes cost and capacity vary in nearly the same ratio. It is, therefore, cheaper to construct a small dynamotor than a motor generator of equal capacity, but in large sizes either equipment is made for about the same outlay. In the matter of required space the dynamotor has an advantage, whatever the capacity.

The losses in a dynamotor are very nearly equal to those that occur when its frame is wound and operated as a dynamo of double the transformer output. For a motor generator the losses are about the same as those in two dynamos, each delivering an equal amount of energy with the motor generator. With equally good design, the losses in two duplicate dynamos are materially greater than the loss in one having an output equal to their combined capacity, and the losses in a dynamotor are, therefore, less than those of a motor generator. For either case, however, the efficiency must be lower than that of a simple dynamo of equivalent output. Take, as an example, the cases of a dynamotor and of a motor dynamo each delivering 10 kilowatts at a speed of about 1000 r. p. m. The efficiency of a dynamo built on the 10-kw dynamotor frame, at the speed named, may be fairly taken at 90 per cent, and the efficiency of each of the two machines for the motor dynamo at 86 per cent. As the change from a dynamo to a dynamotor reduces the output about one-half, but leaves the losses nearly constant, the 10 per cent loss for the dynamo becomes $.10 \div .50 = 20$ per cent loss for the dynamotor, and its efficiency is, therefore, about 80 per cent. For the motor dynamo the efficiency is found from $.86 \times .86 = 74$ per cent, showing 6 per cent less than the dynamotor; enough to make a material item at the end of a year, if energy is bought at usual rates. With the efficiencies just found the dynamotor must consume electric energy from the supply at the rate of $10{,}000 \div .80 = 12{,}500$ watts, and the motor dynamo at the rate of $10{,}000 \div .74 = 13{,}500$ watts. At the low rate of $100 per electrical horse-power, or $133 per kw-year, the excess, in cost of operation at full capacity, for the motor dynamo over the dynamotor is, therefore, $133 (13.500 — 12.500) = $133.

Both machines, in motor dynamo sets, exhibit the usual tendencies to sparking at commutators and the necessity for changes in brush positions at different loads, just as though one was operated independently of the other. In dynamotors these results of armature reaction are absent, because the two independent sets of armature coils exert equal and opposite tendencies to distort the magnetic flux in the air-gap, and consequently neutralize each other in this respect. The fact that brushes may and should remain in a fixed position on the commutators of dynamotors materially reduces the attention for these machines. In motor dynamos, each machine having independent magnets, magnet coils and armature, the output of the dynamo part may be regulated as in the case of a separate generator. The required regulation usually involves a change of the pressure at which the output is delivered, and such changes are readily effected by suitable variations of current in the magnet coils of the dynamo. In some cases the range of this pressure variation is quite small, as for incandescent lighting, but in other cases it involves a large part of the dynamo capacity, as is frequently the fact in boosters. Motor dynamos are especially suited to those cases where a variable electric pressure must be had and are generally used in them. The voltage of the dynamo coils on the armature of a dynamotor is practically independent of the amperes flowing through its magnet coils, but depends directly on the voltage at which the motor coils on the armature are supplied and on the number of turns in each set of coils. Any change in the exciting current of the magnet coils of a dynamotor simply results in a change of the speed of rotation, sufficient to keep the counter e. m. f. of the motor coils and the direct e. m. f. of the dynamo coils, on the armature, constant. The number of turns in both of the armature windings are fixed by the construction, and the voltage of supply cannot usually be varied to meet the requirements for pressure regulation at the dynamo terminals. Dynamotors are, consequently, largely confined to those uses where the regulation of dynamo voltage is very small or entirely unnecessary. Some regulation may be had by means of a rheostat in either the circuit of the motor or of the dynamo coils on the armature, but any extended regulation of this sort results in a relatively large loss of energy, since one of the armature currents passes through the rheostat.

A lack of efficient means of pressure regulation for the output of dynamo coils has prevented the use of dynamotors in many cases where lower first cost, higher efficiency and more compact form make them desirable instead of motor dynamos. Means have, therefore, been sought to accomplish the necessary amount of regulation and at the same time retain the advantages incident to this class of machines. One method of regulation that has been put into successful practice includes a division of the armature core into two distinct parts, one of which is much smaller that the other. The larger part of the armature core contains both the motor and the dynamo windings, and the smaller part of the core is included by only one set of the armature windings, usually those for the lower pressure, though it may be either. A pair of small magnet poles with separate exciting coils are arranged to act on the smaller part of the armature core, and the electric pressure of the set of coils that includes this small core is regulated by changes of a rheostat in the exciting coil of the small poles. This means of regulation should be quite satisfactory in cases where only a moderate amount of pressure variation is necessary, but as the per cent of required regulation increases, the construction of the dynamotor becomes more nearly like that of a motor dynamo. When the two parts of the armature core become equal, and likewise the two or more pairs of magnet poles and coils, the peculiar advantages of the dynamotor over the motor dynamo will be largely lost. If the motor coils of the dynamotor armature are supplied from a source of alternating current, through a static transformer, the

voltage of the dynamo coils can be regulated by changes of the number of active coils in the secondary of the static transformer. For this last named case a rotary converter with only one set of armature cores would offer a satisfactory and more common solution.

Other methods of regulation will probably be devised as time goes on and the demand becomes more general. The several features in which dynamotors are superior to motor dynamos seem to indicate a much wider application of the former than at present, and that they will to some extent displace the latter for many uses. An extending application of direct currents in the arts, at a variety of pressures, is a large factor in this development.

Ferro-Titanium at Niagara Falls.

Experiments which Auguste J. Rossi has been conducting in what is known as the old Porter house on the lands of the Niagara Falls Power Company, give good promise of resulting in the establishment of another great manufacturing industry at Niagara Falls. Already the Ferro-Titanium Company has been incorporated with a capital of $100,000 to carry on the process of manufacture covered by patents which have been granted to Mr. Rossi. It is the present expectation and intention that a meeting will be held in Buffalo on Sept. 7, at which time the question of erecting a large plant at Niagara Falls will be taken up and no doubt favorably acted upon. This action is likely because of the fact that the product of the furnaces covered by Mr. Rossi's patent has been found most valuable in the production of iron and steel.

In the past it has been the understanding of the iron trade that ore containing titanium was unfit for use, but by Mr. Rossi's methods this class of ore is brought into service and from it the best of steel is manufactured. The value of this to the iron world can best be appreciated when it is known that the American continent contains immense deposits of this class of ore, the great mapority of which is near the surface, is easily mined, and lies close to the consuming markets. In other words, one of Mr. Rossi's discoveries, it is expected, will bring into use, just at a time when people have begun to predict an iron famine, a vast amount of ore which can be treated so as to make it available for all purposes for which iron is used.

It is a well-known fact that during recent years several ferro metals have presented themselves for the recognition of the steel manufacturers of the world. All of them have brought about results valuable in their way, but still the cost of these ferro metals has been and is quite high. Mr. Rossi has directed his efforts to the production of a ferro metal which would combine all the elements of hardening steel with cheapness, and he has produced what is called ferro-titanium. It is given out that this is not the first time it has been made; that it has been made in Germany, and that the Krupps owe much of their success to its use. While this may be, during the time the experimental station has been in operation at Niagara Falls enough of it has been manufactured to make it possible to afford prominent steel makers throughout the country an opportunity of testing its value, with the result that ferro-titanium is given a position which appears to place it as the ideal help steel makers have been seeking. The qualities that it imparts to the steel in which it is used are pronounced most desirable. Reliable data as to the exact results are not yet given out, but experiments in progress are expected to develop much information of this kind. Usually, if a product is improved by the addition of any article, the consumer is willing to pay the customary advanced cost, but where an article is improved and cheapened also, as ferro-titanium promises to do with steel, the consumption must be greatly extended and the work in which it is used benefited.

The marvelous prosperity which the iron industry on this continent has enjoyed, and continues to enjoy, has commanded general attention, until it is now conceded that steel is a great pulse of the country's industrial condition. Many new steel plants are projected, and new sections of the country are capturing them. This is notable of the big works now in course of construction at Stony Point, on Lake Erie, near Buffalo, and others are mentioned for the Buffalo locality, the sites being between the Falls and Buffalo. One of the chief capitalists interested in the Stony Point plant is J. J. Albright, of Buffalo, who also is interested in the Ferro-Titanium Company referred to. Other men of prominence mentioned are Gen. Field, Edmund Hayes, of Buffalo; James MacNaughton, of New York, and C. S. Maurice, of Athens, Pa. Mr. MacNaughton is president of the Ferro-Titanium Company. The product of the present temporary Niagara plant is about 500 lbs. of ferro-titanium a day.

Awards at the Paris Exposition.

In our issue of Aug. 25 we gave the cabled news of the principal awards in the groups 4, machinery, and 5, electricity, to American exhibitors at the Paris Exposition. We have now received from Director F. E. Drake, of those two departments a complete list. The recapitulation shows:

Medals awarded to exhibitors in Group IV, Machinery—Hors Concours, 2; Grand Prix, 8; gold medals, 24; silver medals, 46; bronze medals, 50; honorable mention, 29; total, 159.

Medals awarded to exhibitors in Group V, Electricity—Hors Concours, 4; Grand Prix, 6; gold medals, 14; silver medals, 16; bronze medals, 40; honorable mention, 21; total, 101.

GROUP IV, MACHINERY.

CLASS 19.—*Gold Medal*: Ball Engine Co., William Sellers Co., Geo. F. Blake Mfg. Co. *Silver Medal*: Wheeler Condenser & Engineering Co., Lunkenheimer Co., Clonbrock Steam Boiler Co., Crane Co., Lee Injector Mfg. Co., Ashton Valve Co., Walworth Mfg. Co., Schaffer & Budenberg. *Bronze Medal*: Forbes & Co., American Steam Gauge Co., Ambler Asbestos Air Cell Covering Co., Keystone Engineering & Mfg. Co., Mosher (Charles D.), Taunton Locomotive Mfg. Co. *Honorable Mention*: Direct Separator Co., De Rycke (Joseph), Sherwood Mfg. Co., McDondland (G. T.), United States Metallic Packing Co., Johns (H. W.) Manufacturing Co., Fiske Bros. Refining Co.

CLASS 20.—*Silver Medal*: Mietz & Weiss, H. Morgan Smith Co., Rider-Ericsson Engine Co. *Bronze Medal*: Pelton Water Wheel Co. *Honorable Mention*: Ingersoll-Sergeant Drill Co.

CLASS 21.—*Grand Prix*: Worthington Pumping Engine Co., Batcheller Pneumatic Tube Co., Otis Elevator Co. *Gold Medal*: Olsen (Tinius) & Co., Rand Drill Co., Schieren (Charles A.) & Co., Crane Co., Ingersoll-Sergeant Drill Co., Shaw Electric Crane Co. *Silver Medal*: American Steel Pulley Co., Tyler (W. S.) & Co., Robins Conveying Belt Co., Lunkenheimer Co., Monarch Governor & Machine Co., Rice Gear Co., Thomson Meter Co., Walworth Manufcaturing Co., Chapman Valve Mfg. Co. *Bronze Medal*: Fisher Governor Co., Ludlow Valve Mfg. Co., Ashton Valve Co., Jeffrey Manufacturing Co., Hugo Bilgram, Neptune Meter Co., Stillwell-Bierce & Smith-Vaile Co., Detroit Lubricator Co. *Honorable Mention*: A. H. Henderer's Sons, Bristol Co., Christensen Engineering Co., Dresser (S. R.), Winkley (F. D.), Locke Regulator Co.

CLASS 22.—*Hors Concours*: Kearney & Foot, Standard Tool Co. *Grand Prix*: Brown & Sharpe Mfg. Co., the Pratt & Whitney Co., Bliss (E. W.) Co., Niles Tool Works Co., J. A. Fay & Egan Co. *Gold Medal*: Simonds Manufacturing Co., Chicago Pneumatic Tool Co., Morse Twist Drill & Machine Co., Cincinnati Milling Machine Co., Hendey Machine Co., Warner & Swazey, Norton Emery Wheel Co., Bement-Miles Co., Atkins (E. C.) & Co., Gisholt Machine Co., Jones & Lamson Machine Co., Reed (F. E.) Co., Deering Harvester Co., Bullard Machine Tool Co., Pond Machine Tool Co. *Silver Medal*: Ferracute Machine Co., Cleveland Twist Drill Co., Healy (William P.), Rice Gear Co., Landis Tool Co., Prentice Bros. Co., Q. & C. Co., Walworth Manufacturing Co., Starrett (L. S.) Co., Morgan Machine Co., Gleason Tool Co., Flather & Co., Springfield Machine Tool Co., Clough (Rockwell) Co., Baker Bros., Acme Machinery Co., Horton (E.) & Son Co., Ingersoll Milling Machine Co., Becker-Brainerd Milling Machine Co., Fellows Gear Shaper Co., Gould & Eberhardt, Curtis & Curtis, Smith (H. B.) Machine Co., Doig (W. S.), Flather Planer Co., Becker (John). *Bronze Medal*: Bickford Drill & Tool Co., Cincinnati Planer Co., Standard Pneumatic Tool Co., Quint (A. D.), LeBlond (R. K.) Machine Tool Co., Dock (Herman), Crane Company, Safety Emery Wheel Co., Morton Manufacturing Co., Geometric Drill Co., Potter & Johnson Co., Barnes (W. F. & John) Co., Builders' Iron Foundry, Westcott Chuck Co., Waterbury Tool Co., Grant Machine Tool Works, Gorton (George) Machine Co., Goodall, Pratt Co., Oster Manufacturing Co., Hoggson Pettis Mfg. Co., American Tool & Machinery Co., American Machinery Co., Pearson Machine Co., Springfield Mfg. Co., Whitman & Barnes, Bradford Mill Co., American Turret Lathe Works, Tremont Co., Oneida National Chuck Co., Fosdick & Holloway Machine Tool Co., Prentiss Vise Co., Hart Manufacturing Co., Pratt Chuck Co., Vitrified Wheel Co., Armstrong Bros. Tool Co. *Honorable Mention*: Errington (F. A.), Perkins Machine Co., Oesterlein Machine Co., D'Armour & Littledale, Slocomb (J. T.) & Co., Almond (T. R.), Ransom (Perry), Nicholson (W. H.) & Co., Walker (O. S.) & Co., Eames (G. T.) & Co., Universal Machine Co., Leland-Faulconer Manufacturing Co., Baldwin, —, Clarke (James), American Tool & Machinery Co.

GROUP V, ELECTRICITY.

CLASS 23.—*Hors Concours*: Adams-Bagnall Co., General Electric Co., Hecla Iron Works, Malcolmson (Charles T.). *Grand Prix*: American Steel & Wire Co., Westinghouse Electric & Mfg. Co. *Gold Medal*: Bullock Electric Mfg. Co., Lorain Steel Co., Western Electric Co. *Silver Medal*: Crocker-Wheeler Electric Co., Jeffrey Manufacturing Co., Eureka Tempered Copper Co., Shaw Electric Crane Co. *Bronze Medal*: Vulcanized Fibre Co., Anderson (Albert & J. M.), Belknap Motor Co., C & C Electric Co., Jenney Electric Manufacturing Co., Milwaukee Electric Co., Stow Manufacturing Co., Thresher Electric Co., Triumph Electric Co., Lakon Transformer Co., Pittsburg Transformer Co., Thomas (R.) & Sons Co., New York & Ohio Co., Standard Paint. Co. *Honorable Mention*: Garton-Daniels Co., Wagner Electric Mfg. Co., Circular Loom Co., General Equipment Co., Chase-Shawmut Co., Crown Woven Wire Brush Co., Crouse-Hinds Electric Co., Holmes Fibre-Graphite Co.

CLASS 24— *Grand Prix*: Acheson (E. C.)

CLASS 25.—*Gold Medal*: Alvin Mfg. Co., National Carbon Co., Tiffany Glass & Decorating Co., Toerring (C. J.) Co., Ward Leonard Electric Co., Helios-Upton Co., Holophane Glass Co., Hart & Hegeman Mfg. Co., Mica Insulator Co. *Silver Medal*: Bristol Co., New York & Ohio Co., Oxley & Enos, Pass & Seymour, Iron Clad Resistance Co., Phelps Mfg. Co., Dale Co., United States Carbon Co. *Bronze Medal*: Almond (T. R.), Chase-Shawmut Co., Frink (I. P.), Chicago Fuse & Wire Co., Incandescent Electric Light Manipulator Co., Inglis (William) Wire & Iron Works, McLeod, Ward & Co., Meyrowitz (E. B.), American Electrical Novelty Co.

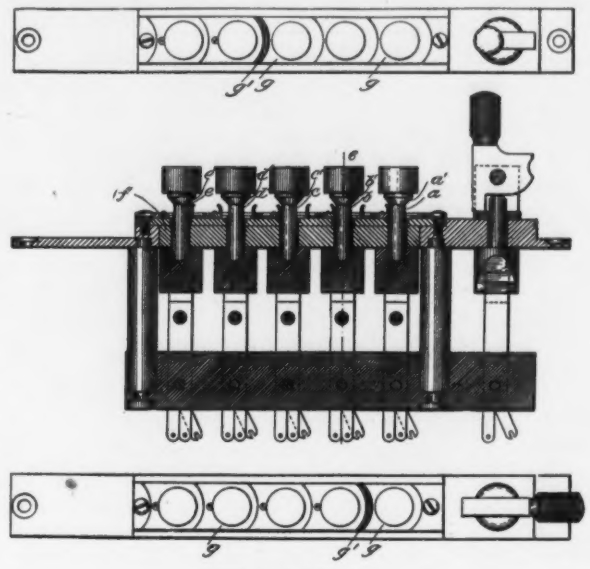
CLASS 26.—*Grand Prix*: Rowland Telegraphic Co., Western Electric Co., John A. Roebling's Sons Co. *Gold Medal*: Edison Phonographic Works. *Silver Medal*: American Wireless Telegraph Co., International Cable Directory Co., Herzog Teleseme Co. *Bronze Medal*: American Electric Telephone Co., Dick Tool Co., Farr Telephone & Supply Co., Foot, Pierson & Co., Huebel & Manger Mfg. Co., Partrick, Carter & Wilkins, Safety Insulated Wire & Cable Co., Sprague Electric Co., Standard Telephone & Electric Co., Stromberg-Carlson Telephone Co., Telephone Manufacturing Co., Western Telephone Construction Co. *Honorable Mention*: Anderson (H.), Insulating Saddle Staple Co., Klein (Mathias) & Son, Pennsylvania Electric Co., Viaduct Manufacturing Co.

CLASS 27.—*Gold Medal*: Weston Electrical Instrument Co. *Silver Medal*: Ritter Dental Mfg. Co. *Bronze Medal*: Marshall (William), Meyrowitz (E. B.), Wagner Electric Mfg. Co., American Electrical Heating Corp'n; Sempire Clock Co. *Honorable Mention*: American Electrical Specialty Co., Eldridge Electric Mfg. Co., Gold Car Heating Co., American Electric Heating Co., Gordon Battery Co., Hadaway Electric Heating & Engineering Co., McCay Engineering Co., Abbot Electric & Mfg. Co.

Signaling Apparatus for Party Telephone Lines.

An interesting patent taken out recently by Josef Steiner and W. H. Tuck, of Brooklyn, N. Y., has been assigned by them to the Western Electric Company. It relates to a selective signaling appliance for party telephone lines, and has for its object to provide improved means for recording or noting the identity of a party-line station which has been called or signaled from the central office after the completion of a connection therewith initiated at some other line, so that a second signal may be transmitted to the same station in case the called subscriber should fail to respond to the first signal.

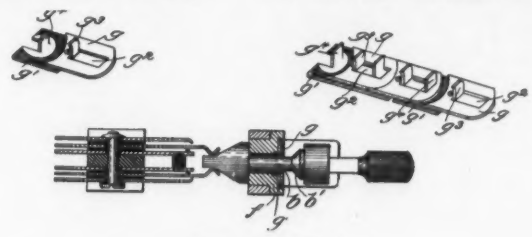
In a party-line telephone system where a number of substation instruments are connected to the same line circuit there is usually provided at the central office an appliance known as a "party-line ringing key," associated with each pair of plugs and their plug circuit, for selectively signaling any station on the line to the exclusion of the other stations. This party-line ringing key ordinarily consists of a number of plungers which are adapted to be manually depressed by the operator, each plunger serving to actuate a circuit-changing switch. Each of the circuit-changing switches when actuated is adapted to connect with the plug circuit and so with the telephone line a source of signaling of calling current of suitable character to operate the signal bell at a particular substation on the line to the exclusion of the bells at the other substations. In accordance with this invention the plungers are mounted one behind another in a row, and a number of target-concealing shields are associated with the row of plungers, being mounted one behind another in a row, one shield for each plunger. These shields are adapted to slide to and fro for a limited space in a suitable bed-plate, and means are provided whereby each plunger as it is depressed opens the row of shields at an adjacent point, pushing the shields to one side or the other to make the opening. The gap thus created in the row of shields displays a target underneath, so that this target remains set until another key is depressed to close the gap thus made and open another one adjacent to itself. The target thus displayed serves to indicate to the operator the identity of the last key which has



FIGS. 1, 2 AND 3.

been depressed, so that if she should have occasion to transmit a second signal, as in the case where the called subscriber does not respond to the first signal, she will know at a glance which keys she previously depressed—that is to say, which station was signaled—without any effort of memory on her part. The target which is displayed whenever two adjacent shields are separated consists of an extension of one of the shields passing underneath the other shield and colored to distinguish it from the face of the shield—that is to say, the shields overlap one another and each is provided with a colored target portion which is normally concealed by an adjacent shield, but which is displayed when the plunger of such other shield is depressed.

Fig. 1 is a plan view of a ringing key equipped with the indicators of this plan. Fig. 2 is a sectional view in longitudinal elevation. Fig. 3 is a plan view similar to Fig. 1, except that a different key is depressed and the row of shields thus separated at a new point and the opening shown in Fig. 1 now closed. Fig. 4 is a detail perspective view of one of the shields. Fig. 5 is a detail perspective view showing three shields in a row to illustrate clearly the manner in which they are associated with one another, and Fig. 6 is a cross-section on line *6 6* of Fig. 2. The drawings illustrate a listening



FIGS. 4, 5 AND 6.

key and a ringing key having five buttons or plungers, all mounted upon a single support, forming a unit or self-contained key set for a plug circuit, which is adapted to be placed in the switchboard as a unit. The five plungers *a b c d e* are mounted in a frame *f*, one behind another in a row. Each plunger has a circuit-changing switch associated therewith operated by the depression of the plunger, and each plunger has a button on top by which it may be manually depressed.

A bed is formed in the framework of the appliance underneath the row of push-buttons, in which bed a number of indicating shields are adapted to slide to and fro. There are five of these shields, one

for each of the push-buttons or plungers, of which the four at the right are mounted to slide to and fro in the bed-plate and the one at the left-hand end is stationarily mounted. Each plunger or push-button is adapted when depressed to open the row of shields at a point adjacent thereto, pushing the shields along and making a gap in the row. Targets are provided which may be seen through the opening in the row of shields wherever that opening may be made, so that when each key is depressed it displays a target adjacent to itself, which may be seen in the opening or gap which has been made in the row by the depression of that button, thus serving to indicate to the operator which of the keys has been depressed.

The shields are constructed as shown in detail in Figs. 4 and 5. Each shield has an upper portion g, which is adapted to engage closely with its neighbor on both sides and has in addition a target portion, which consists of an extension g' passing under the shield next ahead of it. In other words, the shields overlap one another, and they normally overlap to such an extent as to cover up all the target portions except one—the selection of the one which is uncovered being determined by the depression of the plungers. Each shield has a slot g^2 therein through which the rod of a plunger passes. Each shield has two tongues g^3 g^4 formed thereon, one of which tongues, g^3, is adapted to be engaged by a wedge-shaped portion of the push-button or plunger, whose rod passes through it. The other tongue, g^4, of each shield is formed on the end of the extension or target portion thereof and projects up through the slot g^2 of the shield next ahead of it, and is adapted to be engaged by the plunger or push-button associated with the last-mentioned shield. The forward tongue, g^4, is adapted to slide to and fro in the slot g^2 of the shield next ahead and normally occupies a position some distance from the extremity of the slot in such forward shield. The target portion of each shield is thus associated with the push-button next ahead of it, and when that push-button is depressed the tongue g^4 of the shield is engaged and pushed rearwardly (to the right as shown in the drawings) toward the extremity of the slot, thus moving the shield backward and causing its target to be uncovered in the gap created between the upper edges of the two shields.

The bed in which the row of shields is adapted to slide is just long enough so that the target on some shield must always be uncovered, the target selected being determined by the key which is depressed.

CURRENT NEWS AND NOTES.

MR. EDISON is reported to be doing some good work in the field of obtaining electricity direct from coal, or heat, resuming experiments begun several years ago. An early statement of results is promised by the newspapers.

A TROLLEY CAR TREED.—At Beaver Falls, Pa., on Aug. 24, a closed car on the River View line jumped the track on a steep grade, overturned, and plunged into two trees, where it hung suspended 150 ft. above the Fort Wayne Railroad tracks. There were about 50 passengers, several of whom were seriously injured.

WIRE TAPPING.—Two telegraph operators, Jack Reif and C. E. Fisher, tapped the Western Union Telegraph wire just outside the town of Uvalde, Texas, a few days ago, and through forged messages secured the sum of $4,500, with which they fled into Mexico. Fisher presented a draft for that amount on the bank of J. Woods & Son, of San Antonio, while Reif presided over the tapped wire and vouched for Fisher's standing with the San Antonio bank.

OLD-TIME TELEGRAPHERS' ASSOCIATION.—The programme of the twentieth annual reunion of the Old-Time Telegraphers' Association and the United States Military Corps, which will be held in St. Paul and Minneapolis on Sept. 18, 19 and 20, has been issued. The business meetings of the two Associations will be held on the morning of Sept. 18, the Military Telegraph Corps meeting following that of the Old-Time Telegraphers'. The rest of the time will be occupied in sightseeing and entertainment.

THE EDISON CONVENTION.—As announced in these pages last week, the Association of Edison Illuminating Companies is holding its annual convention this week at Saratoga, at the Grand Union Hotel. An excellent programme of papers has been provided, and there is a good attendance. The convention remains in session until Thursday, and on Friday will wind up with an excursion to Schenectady, where the General Electric Works will be visited, and golf will be played. The present president is Mr. John W. Lieb, Jr.

A DOCTOR'S AUTOMOBILE.—In a paper read recently before the Engineers' Society of Western New York, Dr. T. J. Martin, speaking of his automobile, said: "I have operated this carriage in this city for the past three winters and two summers, covering about 35,000 miles. It has never cost me over three-fourths of a cent per mile for current. The cleansing of the batteries costs about $25 a year. The cost of tires, one set per year, is about $80. Paint and varnish about $20. These are the principal items of maintenance." The machine is of Columbia type.

MOTORS IN RUSSIAN NAPHTHA INDUSTRY.—Electric motors having proved both financially and technically advantageous at the great concern of Nobel Bros., considerable extensions of the existing plant are being made. There have hitherto been two gas motors, of respectively 120 horse-power and 50 horse-power, for which the gas was delivered from a special gas works, and which have been employed in the generating of electricity; but two new engines of 150 horse-power each have now been erected, and lines have been carried to all the boreholes which are being worked in the south Russian oil fields.

AUTOMOBILES FOR MAILS.—The tests to which an electric vehicle has recently been put by the New York post office in collecting mail from street boxes were finished last week. F. B. Driscoll, assistant superintendent of mails, has made a report on the tests to his superior. The report deals solely with the collection of mails made by the help of the motor vehicle from letter boxes on Twentieth, Twenty-first, Twenty-seventh and Twenty-eighth streets. The report shows that the tests were made at times when the streets were most crowded with traffic, and at a rough estimate shows an average of time saved of fifteen minutes per trip. In all twenty-two trips were made. There were only two instances of delay noted. One was caused by a slight derangement of wires and the other by the vehicle getting an iron hoop entangled in the gear.

LETTERS TO THE EDITORS.

The Method of Insulation by Freezing.

To the Editors of Electrical World and Engineer:

Sirs: With reference to your article on "Insulation by Freezing," in the issue of Aug. 25, may I be permitted to point out that the patents referred to are invalid, as this method was fully described in my paper on "Insulation and Conduction," read before the American Institute of Electrical Engineers in 1898, and printed in its Transactions (Trans. A. I. E. E., 1898, page 14). The passage is as follows: "The second (plan) occurred to the writer on reading Elihu Thomson's article on the use of liquid air as an insulator. It is this: Since ice at only 12 degs. below freezing has a specific resistance of over 1000 megohms, i. e., as good as some brands of insulation, why not make the conductors hollow, lay them in a trench filled with water, pass cold brine through the pipes, use the brine for cooling houses, making ice, etc., and let the frozen water act as the insulator. A rough calculation shows that this is commercially feasible, even neglecting all sources of profit from the furnishing of the brine, i. e., if it were used only for cooling the pipes. After making all allowance for friction of fluid, cost of power, etc., the balance comes at the right end, if the line is always fully loaded."

This was published more than two years prior to the date of application of said patents, the said date being June 15, 1900.

REGINALD A. FESSENDEN

Weather Bureau, Rock Point, Md.

Resonance Effects.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue for Aug. 11, 1900, you inquire for information regarding cases of severe apparent resonance which may have come under the notice of your readers. We have had no resonance effects on any of our cables while in service, but we have on several occasions noticed effects which were attributed to resonance oc-

curring during the testing of our cables. The first case coming under our notice was at the time of our first experience in testing rubber-covered 150,000 cm duplex 1000-volt feeder cables of lengths varying between 5000 and 7000 ft. We began our tests on the longest feeder, using 140-cycle current. This current was supplied by a 150-kw Westinghouse alternator, the fields of which were connected directly to the armature of a separately excited exciter; the testing voltage being controlled by varying the exciter field. The tests were being made at 10,000 volts, the voltage being determined by a pair of needle points shunted across the testing leads. Two 40-kw 1000 to 4000 transformers with their high-tension coils in series furnished the current for testing. A Stanley voltmeter was connected to the 100-volt side of a 1000 to 100 transformer which was connected to the primary of the two 40-kw transformers. We also had an ammeter in the high-tension testing leads. Beginning with the longest cable, we noticed that the current jumped across on the needle points set for 10,000 volts, when the Stanley voltmeter indicated a few hundred volts less than 10,000. As we tested the shorter feeders in turn, the difference between the voltage as indicated by the Stanley voltmeter and as indicated by the needle points increased, until, in the case of the last feeder tested the current jumped across on the needle points immediately upon closing the primary of the transformers with the exciter field open. The discharge at the needle points was very sharp and rapid, the reports sounding exactly like the discharges from a large static machine. We then discontinued test at 140 cycles, and made all future tests at 60 cycles. This eliminated all trouble with the above mentioned cables.

We have also noticed some trouble, apparently due to resonance, in testing some paper insulated 150,000 cm duplex 1000-volt cables having a length of about 1000 ft. In this case the effects produced were somewhat different. When gradually increasing the pressure and with the needles set for, say, 6000 volts, there would be an intermittent discharge across the needle points when the voltmeter indicated considerably less than 6000, say, 5000 volts. This occurred repeatedly, and was not due to faulty calibration of the static voltmeter shunted across the needle points. This trouble was eliminated in two ways; first, by increasing the capacity of the cables being tested. This was done by testing two or more cables at a time. Second, by increasing the inductance in the circuit of the high-tension testing leads. This was done by inserting the primary of a transformer into one of the testing leads between the step-up transformers and the needle points.

In the first instance above mentioned, the trouble was ascribed by us as due to resonance affecting the fundamental wave. In the second case it was ascribed to resonance affecting the higher harmonics, as the needle points and the high-tension static voltmeter indicated very different voltages.

HARMONICS.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Temporarily Conducted by E. F. ROEBER, Ph. D.

DYNAMOS, MOTORS AND TRANSFORMERS.

Three-Phase Current Booster.—ZWIEFEL.—An illustratrated description of a three-phase current booster to be used for varying the voltage at the receiving end, if constant voltage is furnished from a station; or for keeping the voltage at the receiving end constant, if the voltage at the generator end varies. It may also be used in connection with synchronous converters, which are employed for charging a storage battery, as the voltage required at the end of the charge must be about 30 per cent higher than at the beginning. The apparatus is somewhat like a three-phase transformer with variable mutual induction. Its construction is similar to that of an induction motor, but the "rotor" is kept in its place for each step of regulation; the regulation is obtained by turning it, and thus altering the relative position of the primary and secondary coils. In the adjoining figure *F* represents the coils of the fixed part, which are in series with the three phases, while

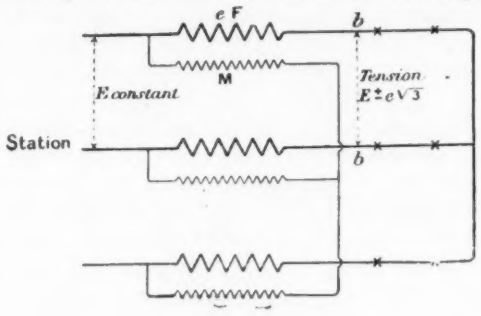


FIG. 1.

M are the coils of the movable part, which are shunted across the phases, as seen in the diagram. If the current furnished from the station has constant voltage *E*, the e. m. f. induced in each of the coils *F* may be *e*, then the current delivered from the booster has a voltage which is the geometrical sum of *E* and $e\sqrt{3}$. The value of this geometrical sum varies with the phase difference between *E* and *e*, as will be seen from the adjoining figure; and this phase difference varies, when the relative position of the coils *F* and *M* varies. In the figure *O A* represents the voltage *E*, and the radius of the circle is $e\sqrt{3}$; AB^1, AB^2, AB^3, AB^4, etc., are the voltages of the currents given out from the booster in different positions of the secondary coils. The apparatus in this form has two inconveniences: there is a torque tending to revolve the armature, so that a brake must be used in order to keep it in the required position; and in order to turn it in a direction opposite to that in which the torque tends to turn it, a considerable external torque must be applied; also there is a varying phase difference between the e. m. fs. received and given out. Both inconveniences may be overcome by building the machine double, so that the torque of one booster is opposite to that of the other; if the e. m. f. *O B* of one booster is leading before *O A* by a certain angle, the e. m. f. *O B* of the other booster is lagging behind *O A* by the same angle, and the resultant e. m. f. is in phase with *O A*.—*L'Ind. Elec.*, July 10.

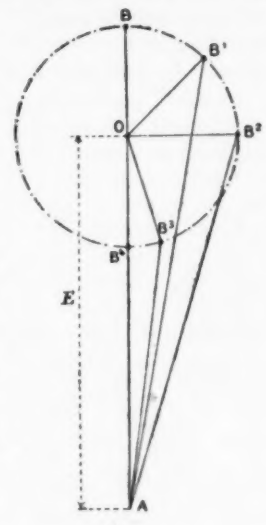


FIG. 2.

REFERENCES.

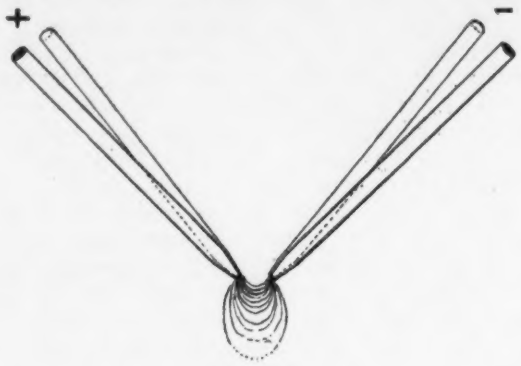
Induction Motors.—FISCHER-HINNEN.—Continuation and conclusion of his long illustrated serial on the calculation of induction motors (Digest, Aug. 18). The paper contains many long tables well adapted for practical purposes.—*Zeit. fuer Elek.*, July 29, Aug. 5, 12.

Induction Motor.—GOLDSCHMIDT.—An illustrated article in which he develops several diagrams for illustrating the action of the induction motor. They are of the type of the Heyland diagram, but partly simpler, partly more general.—*Elek. Zeit.*, Aug. 16.

LIGHTS AND LIGHTING.

Bremer Arc Light.—RUHMER.—An illustrated article giving some information about the new Bremer arc lamp. As noticed in the Digest July 28, the principal feature of Bremer's invention is that a great improvement in the economy of working of arc lamps is obtained if 15 to 50 per cent of non-conducting metallic salts, for instance, compounds containing calcium, silicium or magnesium, are added to the carbons. There is no complicated device for keeping the distance between the carbon ends constant. As shown in the adjoining figure, for each pole two carbons are used, which form an acute angle and are "caused by their weight to slide down to their point of contact." The contact point of the two positive carbons, and also that of the negative carbons, thus remain always at the same place, although the length of the carbons decreases. The positive carbons and the negative carbons form a right angle so that the arc is horizontal; under the influence

of the magnetic field produced between the carbons the arc is blown down as shown in the figure. For lighting the lamp the one pair of carbons is brought into contact with the other by an electromagnet. The lamp is said to be specially adapted for lighthouses, searchlights, etc., as it is less absorbed by steam and fog than ordinary arc lights.—*Phys. Zeit.*, Aug. 18. The first part of Wedding's paper on the Bremer arc light (Digest, July 28), is translated, with the diagrams, in the



BREMER ARC LIGHT.

continuation of the account of the proceedings of the recent annual meeting of the German Elec. Eng. in the Lond. *Elec. Eng.*, Aug. 17.

REFERENCES.

Arc Lamp.—An illustrated description of a feeding device for arc lamps with horizontal carbons, invented by Bouillet.—*Zeit. fuer Beleucht.*, June 10.

Alternating Current Arc Lamp.—An illustrated description of an alternating current arc lamp, devised by Belfield, the main advantage of which is said to be the diminution of noise, which is accomplished by means of elastic pieces of leather or felt.—*Zeit. fuer Beleucht.*, June 20.

Arc Lamps.—Mersch.—A brief illustrated article suggesting to use a chimney, like that of a kerosene lamp, for arc light; its material being a mixture of four parts of plastic clay, three parts of alumina and half a part of kaolin. The arc light is said to get in this way a better color and the consumption of the carbons is said to be diminished.—*Zeit. fuer Beleucht.*, June 30.

Nernst Lamp.—A description of a method of Heraeus for making good joints between the electrolytic incandescent body and the platinum wires connected to its ends.—*Zeit. fuer Beleucht.*, June 10.

POWER.

Water Power Governing.—Cassel.—An article on "Commercial requirements of water power governing." He discusses different methods of governing water power and says that a properly governed water wheel must avoid entirely any shock or strain to the pipe line, and that a properly constructed governor must have in itself the inherent power necessary to perform the governing action. He recommends to arrange the impact wheel so that the buckets against which the water strikes can be moved out of the line of impact, such movements requiring a very slight application of power, and that this necessary power may be taken from the centrifugal force developed in the rotation of the wheel body itself. He suggests the division of the wheel along the centre line of the buckets into two sections, so arranged that any increase in the speed, causing an increase in centrifugal force of the movable parts of the wheel, will cause the two sections of the wheel to separate, allowing the jet of water to pass wholly or in part between the buckets, instead of impinging directly upon them. He remarks that such an arrangement has been found to be entirely practicable, when used in an electric plant during eight months.—*Eng. Mag.*, September.

Test of a Parsons Steam Turbine.—An account of a test of a steam turbine which is one of a pair ordered by the city of Elberfeld, Germany, for its new central station for driving a 1000-kw three-phase current generator. The test was made by Lindlay, Schroeter and Weber. A series of experiments was made to determine the steam consumption under different loads; the average pressure was 11 atmospheres, the steam was superheated 14.3 degs.; for a dynamo load of 1190 kilowatts (overload), 955 (full load), 745 (three-quarter load), 499 (one-half load), 247 (one-quarter load), the number of pounds of steam consumed per kw-hour was 19.3, 20.1, 22.2, 25.4, 33.8 respectively; when running with no load, with the field magnets of the dynamo excited, the turbine used 4057 lbs. of steam per hour; and when the field magnets were not excited it consumed 2604 lbs. per hour. With a gradual change from no load to full load and vice versa, the variation of speed was 3.6 per cent. The drop in voltage, when increasing the load from no load to full non-inductive load, was 1.02 per cent; with inductive load, the other conditions remaining the same, the drop was 11 per cent.—*Zeit. des Ver. Deut. Ing.*; abstracted in *Eng. Mag.* September.

Pumping by Electricity.—Hicks.—A paper giving some information regarding pumping stations installed by the Kern County Land Co., Bakersfield, Calif. By careful tests of many pumps, they found the centrifugal pump the most economical form for their purposes; he says that where electric power can be obtained at a reasonable price, there is nothing which can excel these plants in cheapness of first cost, operation, maintenance and durability. They have developed a special type of centrifugal adapted to low lift and high speed, characteristics which make it possible to directly connect the pumps to standard high speed induction motors. They have operated 25 pumping plants, each delivering from 1400 to 2000 gallons per minute; the average cost of the plants has been about $3,500. They are selling water to the farmers at the rate of 75 cents per acre foot. The installation and operation of the pumping plants are briefly described.—*Jour. of Elec.*, July.

Limits of Electric Transmission.—Adams.—An article in which he compares the economy of a steam-driven electric central station at the centre of use or distribution with that of a generating plant at a place where fuel is very cheap, combined with a long transmission line to the centre of use. He estimates the saving obtained in the second scheme in the fuel cost per hp-hour, and on the other hand the increase in the fixed charges, which generally is far greater than the saving in the fuel cost He concludes that, if absolutely free fuel could be had at a point 100 miles from some of our great cities, the electric transmission of power from the fuel mines to the cities would involve a yearly loss of more than $8.39 per delivered horse-power.—*Sc. Amer.*, Aug. 25.

REFERENCES.

Transmission Plants of Small Scale.—Schindler.—An illustrated article on transmission plants in which a relatively small water power is utilized for furnishing electric current to towns in the neighborhood. Direct current may be generated in the power plant and transmitted to the different towns for charging storage batteries which furnish the supply current. The advantages of storage batteries for this purpose are discussed, and a transmission plant of this kind in Silesia, Germany, is described where a 100-hp water power is utilized to supply current to four storage batteries at four different points in distances of one-half to two-third miles, for lighting and power purposes.—*Elek Anz.*, Aug. 5.

Calculation of Transmission Lines.—Ehnert.—A continuation of the article noticed in the Digest Aug. 11. In this part he deals with three-phase current transmission and shows how to consider resistance, self-induction and capacity in the formulas.—*Elek. Anz.*, July 26, 29.

Three-Phase Current Transmission.—Lenner.—The conclusion of the German translation of the Italian paper (Digest, Aug. 11), on the calculation of a power transmission with three-phase currents with star connection by means of the graphical method. He applies his method for a numerical example.—*Elek. Neu. Anz.*, Aug. 1.

Electricity in the Textile Industry.—A note on a new silk weaving mill in Tyrol, where a polyphase plant has been installed for driving at present 400 looms by means of individual motors.—Lond. *Elec. Eng.*, Aug. 17.

TRACTION.

REFERENCES.

Electrolysis by Return Currents.—A reprint of the report, signed by West, of the commission for investigating the question of electrolysis of gas and water mains by return currents of electric railways. In 90 German cities with electric tramways only in two or three cases electrolysis of gas or water pipes was observed.—*Elek. Zeit.*, Aug. 10.

Electric Locomotive.—An illustrated description of an electric locomotive built by the General Electric Co., of Berlin. It is able to track a train of 300 tons with a speed of 19 miles per hour on a level road. Current at 500 volts is supplied to the locomotive by the trolley system; there are two shunt-wound motors, giving 300 horse-power.—*Elek. Anz.*, Aug. 12.

Sandusky.—An article on the Sandusky interurban electric railways.—*West. Elec.*, Aug. 25.

Paris.—An illustrated article on the Paris Metropolitan Underground R'y, where the third rail is used.—*Sc. Amer.*, Aug. 25.

Conduit versus Trolley.—A reprint from a daily paper of some remarks of Baker in favor of the conduit system, and on the reasons why the London County Council does not want the trolley system.—Lond. *Elec. Eng.*, Aug. 17. These remarks of Baker are very unfavorably criticized in a long editorial, in which the conduit system is said to be unnnecessarily expensive and far too elaborate for the needs of London, in Lond. *Elec. Rev.*, Aug. 17.

Measuring Instrument for Tramways.—KAPP.—An English translation in full of the German paper abstracted in the Digest Aug. 11.—Lond. *Elec.*, Aug. 17.

Automatic Device for Selling Street Railway Tickets.—KRULL.—An illustrated description of an automatic device which when a certain coin is dropped into the slot, gives out a ticket, stamped with date and number; the action of the device is said to be not disturbed by the heavy mechanical shocks which occur on street railway cars.—*Elek. Rund.*, July 1; *Elek. Zeit.*, Aug. 16.

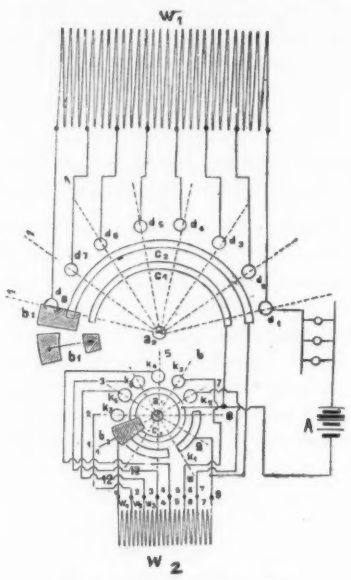
Heavy Motor Vehicles for Road Service.—MAYNARD.—A second article of his illustrated serial (Digest, Aug. 11), describing different types of heavy motor wagons of English make. In none of them is electricity used as motive power.—*Eng. Mag.*, September.

Electric Automobiles.—BAXTER.—An illustrated article on the general arrangement and the different parts of an electric automobile, with illustrations and descriptions of different types of electric vehicles.—*Pop. Sc. Mo.*, September.

Hungary.—A statistical table on the traffic and receipts of the Hungarian electric railways in April, May, June, 1900, compared with 1899.—*Zeit. fuer Elek., Aug.* 5.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Improvement in Regulating Resistances.—An illustrated description of a device of Schuckert & Co. for a step-by-step resistance, allowing to obtain $(n+1)^2$ steps with 2 n contact blocks in the following way: In the adjoining figure W_1 and W_2 are two resistances, each divided into seven equal parts, each of the seven equal



REGULATING RESISTANCES.

parts of W_1 is equal to the whole resistance W_2. c_1 and c_2 are two bent metallic rods, b_1 and b_2 two metallic contacts, b_1 connecting the rod c_1 with the contact blocks d_1, d_2, etc., while b_2 connects the rod c_2 with the same contact blocks. b_1 and b_2 are mounted on the same crank, which can be turned around the axle a_2. b_3 is a metallic contact for connecting the bent metallic rod c_3 with the contact blocks k_1, k_2, etc., and can be turned by means of a crank around the axle a_1. The axles a_1 and a_2 are coupled by a suitable gearing so that the contact b_2 is moved from d_8 to d_7 or from d_7 to d_6, etc., while the contact b_3 has completed a full revolution. In the position illustrated the resistance W_1 and W_2 are in series. If the crank around a_1 is slowly turned in the direction of the hand of a clock, the single parts of the resistance of W_2 are switched out, until only the resistance W_1 is in circuit; in this moment the contact b_2 is about to leave the contact block d_8, while the contact b_1 is about to reach it. By turning the crank farther, the contact b_1 makes connection between d_8 and c_1 until the following position is reached: b_3 has again the same position as in the figure, while b_2 connects now d_7 with c_2, and b_1 connects d_8 with c_1. It will be seen that now the resistance W_2 is in parallel with that part of the resistance W_1 which is between the blocks d_8 and d_7; by further turning the crank around a_1, more and more parts of W_2 are switched out, so that the joint resistance of the two parallel connected resistances becomes smaller and smaller, etc.—*Elek. Rund.*, Aug. 15.

Storage Batteries for Transmission Systems.—POOLE.—A paper, read before the Pacific Coast Transmission Association, and illustrated by diagrams, on "The Application of Storage Batteries for Transmission Systems." He mainly deals with the influence which a battery has on the load factor. If the storage battery is considered from a strictly economical point of view, it necessarily becomes peak apparatus. The width of a peak that can economically be cut off with a battery must be balanced by the price, efficiency and cost of maintenance of the battery against the conditions of cost of generation and transmission. With a steam plant the limit is about two hours; that is to say, if the width of a peak be more than two hours, it is generally more economical to install steam apparatus. With a water-power system, however, the conditions may be such that a much wider peak can be taken with advantage. He assumes a 6000-kw water-power plant for transmission over 90 miles at 40,000 volts and with 10 per cent line losses, the cost of the complete installation being $1,115,000, he assumes that the load variations are such as usual in a combined lighting and traction station. If a battery is installed and 2500 kw are to be taken by it, only 3500 kw in generators are required; the cost of the complete installation is here estimated at $935,460. In the first case, without battery, the total fixed charge (6 per cent interest, 7 per cent allowance for deterioration and repairs, also operating expenses) is $184,950, in the second case with battery, it is $161,609. An account of the discussion which followed is also given.—*Jour. of Elec.*, July.

Electricity in Collieries.—WALKER.—The conclusion of his illustrated article on the applications of electricity in the collieries of Great Britain (Digest, Aug. 11). He deals with the use of electric light in mines, gives brief descriptions with illustrations of Sussman's and Headland's electric miner's lamps with secondary batteries, and also of Walker's lamp worked by a primary single-fluid battery. He also describes methods of electrically lighting a locked safety oil lamp and locking and unlocking it by electricity. He further deals with electric signals in mines, with the installation of the power plant, and with the peculiar problems attending underground transmission and distribution. The shaft cables may be protected from wet and from mechanical injury by either of the following two ways: either by having a very thick covering of rubber outside the conductor, and protecting that with a further thick wrapping of jute yarn thoroughly dried and impregnated with some water-proof substance, with again tapes or braiding, also soaked in the same substance, outside all; or by placing iron pipes in the shaft, in lengths of 50 yards or thereabouts, the pipes being large enough to accomodate easily the two cables, which are insulated and braided in the usual way; at each 50 yards is an iron junction box, fitted water-tight to the pipe, with a junction board for the cables inside; the cables are drawn into the pipes, connected at the junction boards, and the covers of the boxes put on and red-leaded. The article concludes with some remarks on the economy of electricity in mining.—*Eng. Mag.*, Sept.

REFERENCES.

Heating and Lighting Plant.—A brief article on the Evanston Yaryan Company, at Evanston, Ill., which expects to have its system in operation by the latter part of September. The installation that is being put in is what is known as the Yaryan system, by which electric light is furnished by a central station, from which also run hot-water mains for residence and other heating purposes.—*West. Elec.*, Aug. 25.

Heating and Lighting Plant.—STAHL.—His Ohio Electric Light Association paper on "Two Revenues Instead of One, or Electricity as a Bi-Product," noticed in the ELEC. WORLD AND ENG. Aug. 25, p. 284.—*West Elec.*, Aug. 25.

Electric Installation of a Foundry.—An illustrated description of the electrically operated new foundry of the Sargent Company, at Chi-

cago Heights, Ill. The 220-volt two-wire direct-current system is used.—*West. Elec.*, Aug. 25.

Storage Batteries in Central Stations.—White.—His Ohio Electric Light Association paper on "The Desirability of using Storage Batteries in Medium-Size Stations," which was abstracted in the Elec. World and Eng. Aug. 25, p. 284.—*West. Elec.*, Aug. 25.

Switchboard—Perkins.—The second part of his illustrated article (Digest, Sept. 1), dealing with polyphase low-tension switchboards.—*West. Elec.*, Aug. 25.

High-Tension Switchboards.—Bertram.—A long and fully illustrated description of high-tension switchboards, devised by him and built by Voigt & Haeffner, and of special apparatus for high-tension transmission lines.—*Elek. Zeit.*, Aug. 9-16.

Insulators.—An illustrated description of a new type of porcelain insulators for high-tension lines made by a German company.—*Zeit. fuer Beleucht.*, June 20.

Prague.—Bathurst.—The first part of an illustrated article on the central station of Prague, which was already described in the Digest July 21 (Kolben's paper).—Lond. *Elec. Rev.*, Aug. 17.

Buenos Ayres.—The conclusion of the illustrated description of the central station of Buenos Ayres (Digest, Aug. 4, 11, Sept. 1). The station will supply power also to the tramway system, which is now being equipped electrically.—Lond. *Elec. Rev.*, Aug. 17.

Wires, Wiring and Conduits.

REFERENCES.

Heating of Underground Conductors.—Apt.—A brief reply to the criticism of Wilkens (Digest, Sept. 1). He agrees that the theoretical suppositions of his formula are not exact, but says that his formula may be regarded as empirical and has been found to be in agreement with his measurements.—*Elek. Zeit.*, Aug. 16.

Earthing the Middle Wire.—An editorial discussing the question with special references to the paper of Wordingham, abstracted in the Digest Aug. 11.—Lond. *Elec. Rev.*, Aug. 17.

Pole Brackets.—Ehnert.—An illustrated article, with several tables, on the calculation of the brackets of telegraph and telephone poles.—*Elek. Anz.*, Aug. 19.

Electro-Physics and Magnetism.

Wave Form of Alternating Currents.—Benischke.—An article in which he says that, as the arithmetical mean of a half-wave has no practical importance in electrical engineering, it is not to be recommended to characterize the wave form, as Fleming does, by the ratio of the effective value and the arithmetical mean. He suggests to use instead the ratio of the maximum value and the effective value and to call it top factor (Scheitelfactor). In a diagram he gives three different wave forms; while Fleming's coefficients for the same differ by 4 and 5 per cent only, the top factors differ by 18 and 15 per cent, so that the top factor appears to be better adapted to characterize the wave form. It is also preferable, because for magnetic properties the maximum value is of importance, the magnetic saturation and the hysteresis loss depending upon the maximum value.—*Elek. Zeit.*, Aug. 9.

Electric Luminosity of Gases.—Stark.—An outline of a theory on the relation between the electric luminosity of a gas and the voltage drop along the tube, based upon the hypothesis of ions traveling with different velocities. Wherever the voltage drop is a maximum, the gas is illuminated; positive and negative ions travel there in opposite directions. Wherever the voltage drop is a minimum, there is a dark space; there only negative ions travel in the direction of the next maximum. The frequency of the produced oscillations depends upon the velocities of the ions.—*Phys. Zeit.*, June 16; some further remarks on the mathematical representation of his theory in *Phys. Zeit.*, July 14. Two other brief papers by the same author, on the conductivity in a gas tube under the action of two independent e. m. fs. which act in direction perpendicular one to the other, and on the application of such an arrangement for an investigation of the conductivity in gases, in *Phys. Zeit.*, July 7.

A Dieletric in an Electrostatic Field.—More.—An account of experiments showing that the stress occurring in the ether when a dielectric is electrostatically charged causes no mechanical deformation of the substance; at least, if there is such an action it must be extremely minute. He also accounts for the opposite results obtained by previous investigators.—*Phil. Mag.*, August.

Thermoelectricity.—Tsuruta.—An account of experiments in which he investigated some effects of twist on the thermoelectric qualities of iron. He found that in soft iron of certain kinds there exists the phenomenon of thermoelectric hysteresis with respect to twist, at least when combined with longitudinal tension; other things being equal, the hysteresis is reversed at a certain twist; mechanical agitation has its own effects, which are reversed as the hysteresis is reversed.—*Phil. Mag.*, August.

Artificial Radio-Activity.—Villard.—An account of experiments in which he rendered ordinary bismuth radio-active by subjecting it to the action of cathode rays in a vacuum tube.—*Bull. Soc. Franc. de Phys.*, 152; abstracted in Lond. *Elec.*, Aug. 17.

REFERENCES.

Electromagnetic Theory of Physical Phenomena.—Lorentz.—His presidential address at the 325th anniversary of the University of Leyden, on Faraday and Maxwell's electromagnetic theory, and especially on its application to optics.—*Phys. Zeit.*, Aug. 11, 18.

Coherer.—Prasch.—The concluding part of his article giving a summary of the work of the various investigators with the coherer (Digest, Aug. 18).—*Elek. Neu. Anz.*, Aug. 1.

Electrical Waves.—An illustrated description of a device of Braun for increasing the intensity of electric waves of high frequency.—*Elek. Rund.*, July 15.

Electrolytic Conduction of Gases.—Hagenbach.—A preliminary account of experiments in which he investigated gases in the neighborhood of the critical point at which the gaseous state goes over into the liquid state; he could prove that there occurs electrolytic conduction.—*Phys. Zeit.*, Aug. 4.

Ionized Gases.—Villari.—A brief article discussing how electric charges abolish the property of ionized gases to dissipate electricity.—*Rend. Acc. di Bologne*, January; *Phys. Zeit.*, July 21.

Screw Line Discharge.—Toepler.—Some remarks on the peculiar discharge spark in form of a screw line described by Ruhmer (Digest, Aug. 25); he discusses the conditions under which this form of discharge is obtained.—*Phys. Zeit.*, Aug. 11.

Becquerel and Roentgen Rays.—Himsted.—An article describing some experiments made by him with Becquerel and Roentgen rays; Roentgen rays show a considerable influence upon the selenium cell.—*Phys. Zeit.*, Aug. 4.

Zeeman Effect.—Paschen.—An illustrated description of a Geissler tube with mercury electrodes for studying the Zeeman effect; also a brief paper by Runge and Paschen, on the study of Zeeman effect in the mercury spectrum.—*Phys. Zeit.*, Aug. 4.

Zeeman Effect.—Reese.—A summary of our present knowledge about the Zeeman effect.—*Science*, Aug. 21.

Magnetic Susceptibility.—Meyer.—A note on the relation between magnetic susceptibility and atomic volume.—*Phys. Zeit.*, July 7.

ElectroChemistry and Batteries.

Storage Battery Plates.—Wehrlin.—An article pointing out that to make the storage battery more satisfactory, the diffusion of the acid in and at the active mass should be accelerated and the resistance of the active mass should be diminished; both results are obtained by using a very large surface of the plate with a very thin layer of active mass and by constructing the plate so that in the grooves a good circulation of the acid is possible. The more these conditions are fulfilled, the smaller are the differences between the capacities at different rates. These conditions are said to be fulfilled in some types of plates made by Wueste & Rupprecht, which are briefly described, the results of some tests being given in diagrams.—*Zeit. fuer Elek.*, Aug. 12.

Galvanic Cell.—Jungner.—A brief article suggesting the following cell, in which the electrolyte is not changed at all, the whole process consisting in the transport of oxygen (or hydroxide) from the active mass of one electrode to that of the other electrode. He suggests to use at one electrode fine powdered copper or nickel, at the other copper oxide or nickel oxide, and as electrolyte an aqueous solution of caustic potash. If there is cupric oxide at one electrode and copper at the other and the cell is discharged, there is obtained cuprous oxide at both electrodes at the end of the discharge, while the electrolyte has not been changed. He describes the construction of an accumulator devised in this way, and gives some figures about its working; but it seems that he has made no experiments.—*Elektrochem. Zeit.*, August.

REFERENCES.

Storage Battery.—Peters.—A brief article describing experiments which he has made to examine the statement of Schoop that peroxide of lead is decomposed if exposed to direct sunlight (Digest, June 2).

He found that this is not the case.—*Centralblatt. fuer Accum. und Elem. kunde,* Aug. 15.

Electrolysis Without Electrodes.—HEIL.—An article in which he unfavorably criticizes the suggestions of Heuser (Digest, Aug. 18).—*Elektrochem. Zeit.,* Aug.

Electrolytic Estimation of Bismuth.—BALACHOWSKI.—An account of experiments made to find the best conditions for obtaining, by the electrolysis of bismuth salts, a sufficiently adhesive deposit to permit washing and weighing.—*Comptes Rendus,* July 16; abstracted in Lond. *Elec.,* Aug. 17.

UNITS, MEASUREMENTS AND INSTRUMENTS

Magnetic Balance.—DU BOIS.—A description of an improved form of magnetic balance, which is accurate to within 0.5 per cent. The normal sectional area of the specimen to be tested is 0.5 square centimeter; it may be fastened in two different ways, either by ordinary clamps, or, for more accurate work, between concave spherical contacts. The ordinary length of specimens is 25 cm, but for cases of brittle metals and alloys lengths as small as 6 cm may be used. The magnetic field is excited by two coils carrying a current of from 2 to 5 amperes. The magnetic forces generated in the specimen are balanced against two running weights, moving along separate scales, one weight being 25 times the mass of the other. Magnetic balancing is now superior to the ballistic method for most purposes; superior results can only be obtained by the magnetometric study of ovoids, and these therefore offer a means of deciding doubtful cases.—*Ann. der Phys.,* No. 6; abstracted in Lond. *Elec.,* Aug. 17.

Interrupter.—HAERDEN.—An illustrated description of an interrupter, the interruptions occurring between two mercury surfaces in a vacuum. The mercury is contained in a glass tube of a reversed U form, the ends being connected to two air-tight cases filled with mercury. One of these cases is provided with a piston which is moved by means of an electromotor. Whenever the piston is moved out of the case, the column of mercury is interrupted at the highest point of the reversed U-tube, at which point the tube has a rather small cross-section. If pure mercury is used this interrupter is said to render good services in the laboratory.—*Elek. Anz.,* Aug. 2.

Oscillating Meter.—An illustrated description of an oscillating meter of the General Electric Company, of Berlin. A movable coil, supplied with a part of the supply current, oscillates in the field of a permanent magnet; whenever the deviation of the coil reaches its maximum, by a special relay the direction of the current in the coil is reversed and the coil swings back. In order to insure good contacts and to overcome the friction in the bearings, a special device is used, which consists in an iron armature mounted on the axle of the oscillating coil and oscillating in a constant magnet field; it is arranged so that the greatest force is acting in these moments when the oscillating coil is near the points where its direction of swinging is reversed.—*Elek. Rund.,* June 15.

REFERENCES.

Wehnelt Interrupters Active in Parallel.—RUHMER.—An article in which he describes the results of the experiments, noticed already in the Digest, May 12.—*Elek. Zeit.,* Aug. 16.

Rate Meters.—HENDRICKSON.—His paper, abstracted in the Digest Sept. 1, with an illustration of Harris' meter, and an account of the discussion which followed.—*Jour. of Elec.,* July.

TELEGRAPHY TELEPHONY AND SIGNALS.

Telephone Switchboards.—CLAUSEN.—The first part of what promises to become a long serial. He first gives a systematical summary of the different types of switchboards for telephone exchanges, and gives hints how to select a switchboard; he believes that in an exchange in which the immediate capacity is less than 500, or even has already reached the 500 mark, it is not often advisable to install a multiple jack switchboard, but a divided exchange type of switchboard constructed either for the manual call, automatic signal, or central battery system, is by far the most suitable one. In the event, however, that the exchange has already reached the total of, say, 800 subscribers, and that all indications point toward an early increase in the number of new subscribers, it would be advisable to install a multiple switchboard. He then compares the advantages and disadvantages of the magneto call, centralized call, and full central energy systems.—*Tel. Mag.,* Aug.

Telegraphone.—RUHMER.—An illustrated article on Poulsen's instrument, mentioned frequently in the Digest. He says that the reproduction of the sounds by the instrument in the Paris exhibition is surprisingly good. Although it is exhibited at the most unfavorable place, in the machine room, it operates very well. The sounds are reproduced with perfect clearness, the individual characteristics of the voice of the speaker or singer being fully preserved; there are no parasitic sounds. The reproduction is so perfect that even the breathing between different sentences is heard.—*Phys. Zeit.,* July 28.

Wireless Telegraphy.—HAERDEN.—An illustrated description of a new system of wireless telegraphy, which is analogous to that of Zickler, but while Zickler uses those rays which are beyond the violet part of the spectrum, Haerden uses those on the other end, beyond the red part. As receiver he uses a bolometer, the connections being made as in a Wheatstone bridge, or a thermocell.—*Elek. Anz.,* Aug. 19.

REFERENCES.

Wireless Telegraphy.—PRASCH.—Continuation and conclusion of his article on predecessors of Marconi (Digest, Aug. 25).—*Zeit. fuer Elek.,* July 29, Aug. 19.

Luminosity Effects on the Mast Wire.—TOMMASINA.—A German translation with the illustrations of the French article, noticed in the Digest Aug. 4.—*Phys. Zeit.,* July 7. An account of similar experiments, made by Viol, in *Phys. Zeit.,* July 28.

High-Speed Telegraphy.—A brief illustrated paper, read before the Physical Society of Frankfort, on the system of high-speed telegraphy of Pollak and Virag, which was mentioned at repeated times in the Digest.—*Phys. Zeit.,* Aug. 4.

Telegraphy and Telephony.—A summary of improvements and new inventions, made in telegraphy and telephony during April, May, June.—*Elex. Anz.,* Aug. 9.

Microphone.—An illustrated description of a new microphone of Mix and Genest.—*Elek. Zeit.,* Aug. 16.

Berlin.—LINDOW.—A translation in full, with the illustrations, of the German article on a new telephone exchange in Berlin.—*Tel. Mag.,* Aug.

Ottawa.—An illustrated description of the Ottawa exchange of the Bell Telephone Company.—*Can. Elec. News,* Aug.

Battery of the Telegraph Station of Vienna.—A description of the storage battery installation of the telegraph central station of Vienna. The switchboard is described and illustrated in a diagram.—*Elek. Neu. Anz.,* Aug. 1.

Sweden.—A brief article giving some information about telephony in Sweden.—*Sc. Amer.,* Aug. 25.

MISCELLANEOUS.

REFERENCES.

A. I. E. E. Visit to London.—Very full account of the visit and of the speeches at the lunch on Aug. 12 and at the dinner on Aug. 13, in *Lightning,* Aug. 16; briefer articles in Lond. *Elec. Eng., Elec. Rev.* and *Elec.,* Aug. 17.

Production of High Temperatures.—ARCHDEACON.—A long, illustrated article on the Goldschmidt process for the generation of intense heat by working aluminum with the oxides of other metals, as noticed at repeated times in the Digest. He describes the applications of this process for the reduction of metals, such as chromium and manganese, which up to the present time it has been impossible to obtain on a commercial scale, except as ferro-alloys; further for the welding together of wrought iron gas and water pipes, of both large and small dimensions; for the welding together of rails for ordinary roads, but more especially for electric tramway purposes; for the repairing of faulty shaftings, steel castings, etc.—*Eng. and Min. Jour.,* Aug. 25.

New South Wales.—An article on the prospect for the German electro-technical industry in New South Wales, giving some information on the development of electric lighting, traction, telegraphy and telephony, and some statistical data on the import of electrical apparatus from 1894 to 1899.—*Elek. Anz.,* Aug. 19.

Kingston.—A long illustrated description of the city of Kingston, which has been the meeting place of the Can. Elec. Ass'n Convention. The article describes the electric street railways, the electric plant of the penitentiary, the part which electricity plays in Queen's University, the plant of the Kingston Light, Heat & Power Co., the Bell Telephone exchange and some smaller electric installations.—*Can. Elec. News,* August.

Manufacturing Glass Electrically.—BERMBACH.—A continuation of his article noticed in the Digest Aug. 18. He discusses some physical questions, especially the thermic and electric phenomena of the electric arc, if currents of 50 or more amperes are used.—*Elek. Anz.,* Aug. 16.

Paris Exposition.—RUHMER.—Illustrated articles on Poulsen's telegraphone; on an apparatus, designed by d'Arsonval, for generating

high frequency currents for physical and medical purposes; and on the Bremer arc light.—*Phys. Zeit.*, July 28, Aug. 4, 18.

An illustrated article on plans and models, exhibited by Miller, Munich.—*Zeit. fuer Beleucht.*, Aug. 10.

A brief summary of the most important electrical exhibits.—*Zeit. fuer Elek.*, Aug. 12.

An illustrated article on exhibits of Ganz & Co., Buda Pest.—*Der Elec. Tech.*, Aug. 15.

A brief article on the electric kitchen in the Spanish pavilion.—*Elec. Rev.*, Aug. 15.

An illustrated description of a 4000-hp three-phase alternator exhibited by the General Electric Co., of Berlin.—*Zeit. fuer Beleucht.*, June 30.

An article on the generation of electric power and on the electric lighting of the Exposition.—*Zeit. fuer Beleucht.*, July 10.

An illustrated description of a three-phase alternator exhibited by Kolben & Co.; also a very brief article on the Nernst lamp at the Exhibition.—*Zeit. fuer Beleucht.*, July 20.

An illustrated description of lamps exhibited by Koerting and Mathiesen, and another brief note on the Nernst lamp at the Exhibition.—*Zeit. fuer Beleucht.*, July 30.

SCHOOP.—A brief illustrated description of the moving platform.—*Elek. Neu. Anz.*, Aug. 1.

An article giving general remarks on electrical exhibits.—*Elek. Anz.*, July 29.

New Book.

BOOK RECEIVED.

MECHANICAL DRAWING AND ELEMENTARY MACHINE DESIGN. By John S. Reid and David Reid. New York: John Wiley & Sons; Chapman & Hall, Limited, London. 389 pages, 301 illustrations. Price, $3.00.

Directory of Electrical Societies, Etc.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Next meeting, New York, Sept. 25, 26 and 27, 1900.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Kansas City, Mo., Oct., 16, 17, 18 and 19, 1900.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Ottawa, Ont., 1901.

NATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Pittsburg, Pa., Sept., 25, 26 and 27, 1900.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND THE U. S. MILITARY TELEGRAPH CORPS. Next meeting, Minneapolis, Minn., Sept. 18, 1900.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Next meeting, Buffalo, Sept. 18 and 19.

Automobile Motors.

BY J. C. LINCOLN.

The requirements of an electric horseless carriage have created a demand for a type of motor not previously produced. The service demands a motor which shall be light, which shall be capable of operating at an overload of several hundred per cent, and which shall at the same time be highly efficient at an ordinary running load. There is no doubt in the minds of automobilists that the variation in power required from an automobile motor is greater than that required from any other type. The street car motor most closely approaches it in function and conditions.

It is very difficult to obtain in the series motor for automobiles a fair efficiency when overloaded, and a high efficiency with regular running loads, on account of the extraordinary variations of load. For instance, in one carriage weighing 1600 lbs. without passengers and 2000 lbs. with passengers, 6800 watts were required to drive it up an 11 per cent grade at a speed of about seven miles per hour. The same carriage with the same load requires 360 watts to drive it on a brick pavement at a rate of eight and a half miles per hour.

It is a well known fact that the efficiency of a series motor is very low until enough current flows through the field coils of the motor to produce considerable magnetic flux, and while the series motor can take extreme overloads with fair efficiency it is apt to have a low efficiency on good smooth ground, because the work required of the motor is so small in the latter condition.

The motor and controller illustrated herewith are designed to overcome in a considerable degree the objections noted. They are built by the Lincoln Electric Company, of Cleveland, Ohio. This machine

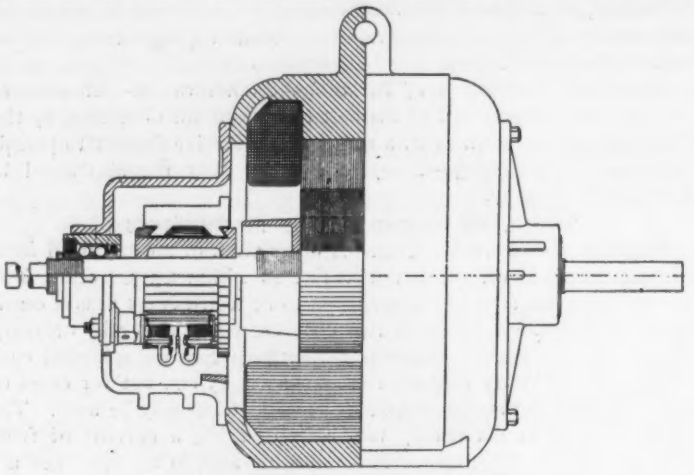


FIG. 1.—SECTIONAL VIEW OF MOTOR.

is compound wound, and the controller is arranged so that the shunt field is constant whatever the voltage on the armature may be. The

FIG. 2.—PERSPECTIVE VIEW OF MOTOR.

strength of the shunt field is the same whether the motor is running with 20, 40, or 80 volts. This arrangement makes it possible

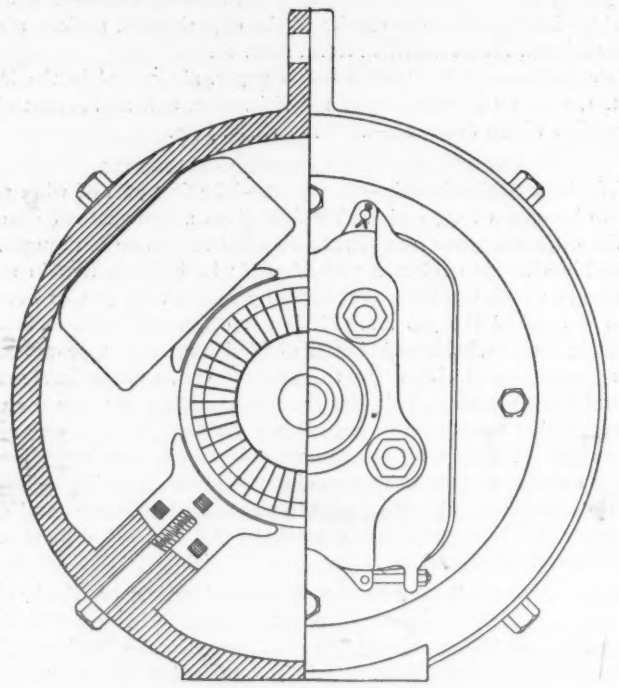


FIG. 3.—CROSS SECTION OF MOTOR.

to obtain a very high efficiency at low loads which is not possible with a series motor. Another very important advantage is the saving of most of the power which is usually wasted as friction in mechanical brakes.

This motor drives a carriage carrying 40 cells of battery and which runs at about 4 miles per hour on the first speed or with 20 volts on the armature. The speed is 8 miles per hour on the second speed with 40 volts on the armature, and 16 miles per hour on the

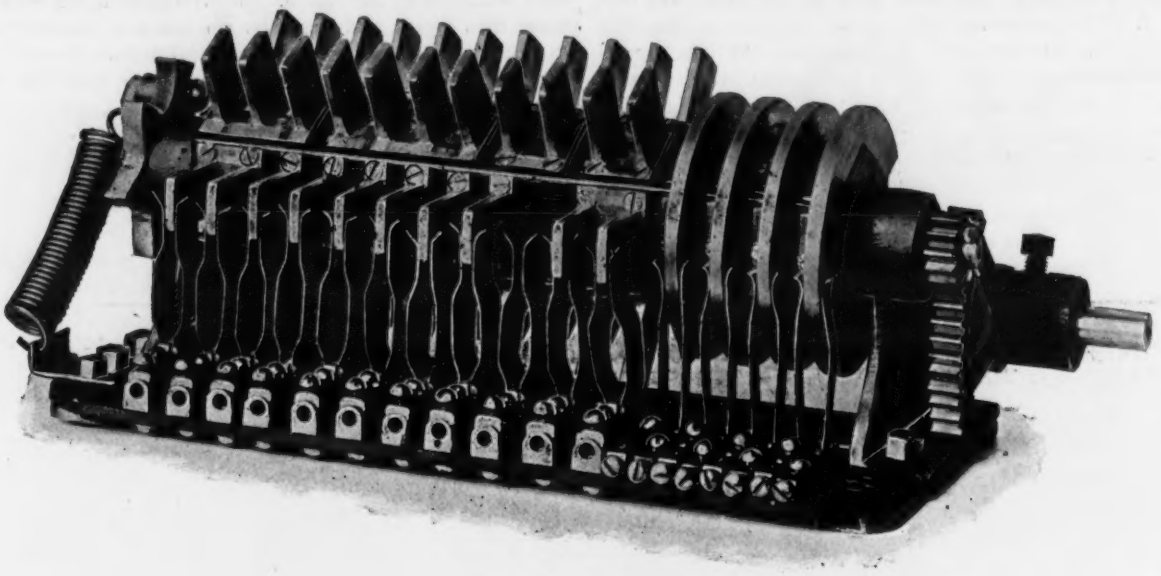


FIG. 4.—THE CONTROLLER.

FIG. 5.—ELECTRIC CARRIAGE EQUIPPED WITH LINCOLN MOTOR.

third speed with 80 volts on the armature. For instance, suppose this carriage is traveling at a rate of about 8 miles per hour and begins to descend a grade, the speed will be increased and the counter e. m. f. of the armature will increase until, at a rate of 9 miles an hour, no current will be consumed by the armature; as the speed rises to about 9½ miles the counter e. m. f. is still further increased so that the motor becomes a generator and charges the batteries. Any greater increase in the speed of the carriage is impossible because a slight increase in the speed will very greatly increase the load on the motor by increasing the charging current. If it is desired to descend a hill at a lower rate of speed than between 9 and 10 miles per hour, the controller can be moved to the first speed, and it will be impossible for the carriage to descend at a higher rate of speed than 5 miles an hour; and the power which would have been wasted in the friction of the mechanical brakes in descending the hill will be used in driving the motor acting as a dynamo and charging the storage batteries. This is also valuable in bringing the carriage to rest on level roads. If the carriage is traveling at the highest speed and the controller is moved to the second speed the momentum of the carriage drives the motor as a dynamo and rapidly charges the battery until the speed drops to 8 or 9 miles per hour. When the speed decreases so that the batteries are no longer being charged, the controller can be placed at the first speed and a still further charge of the batteries effected. This brings the speed to about 4½ miles per hour. The moving energy of the carriage can be returned to a battery in point of speed from 10 to 4 miles per hour.

The carriage shown in the illustration is equipped with one of these motors and can be handled with ease, giving the operator perfect control of the vehicle, especially when driving through crowded streets.

Alternating Current Arc Light Work.

Among the papers presented at the recent meeting of the Ohio Electric Light Association was one by Mr. H. W. Hillman, of the lighting department of the General Electric Company. It has now been issued by the company in pamphlet form, with illustrations, and constitutes an interesting and valuable little monograph on the art.

One of the instances cited by Mr. Hillman of the adoption of the alternating arc is that of the Gas & Electric Company, of Fort Plain, N. Y., which has furnished commercial and street lighting for the past twelve years. The old equipment consisted of a high-frequency alternator with belt-driven arc machines. About a year ago a series alternating system with one 50-light transformer, one 25-light transformer, 42 arc lamps and 45 100-cp incandescent lamps was introduced. The service is two-phase, a transformer being installed on each of the phases. Notwithstanding that one is a 50-light and the other a 25-light transformer, the two phases are balanced on the commercial circuits within three volts. The system has been operated for about twelve months, without any expense whatever for repairs. Only a half-day, once a week, is required to trim the lamps. The space occupied at the station for the arc lighting system is only 4 x 15 ft. (Fig. 1.) Notwithstanding that the primary voltage from the transmission line is quite variable, the current of the arc system remains perfectly steady, because of the excellent regulation of the transformers. Fig. 2 illustrates a simple arrangement for automatically switching off the lamps at daybreak. A battery circuit energizes two magnets—the circuit being closed at the proper time by an ordinary alarm clock. When these magnets are energized, a weight is released, which opens the primary switches of both transformers, thus opening the street lighting circuits. As current is taken from a distance, and there is no generator in the station to require attention, the device referred to above makes it unnecssary to have any attendance whatever at the station. The arrangement has been in service for more than a year, and has never yet failed to operate.

The paper enters into many practical details of cost, operation, etc., and gives the following comparative data that will interest many readers: A report from a station where a 100-light transformer and 100 lamps were operated for over a year states that not a cent has been expended for parts for either the transformers or the lamps. A report on six transformers in operation for more than two years, shows that the only expense for maintenance has been a small chain, costing not more than 10 or 15 cents. The exact annual cost of operating enclosed and open arc lamps has been frequently discussed. The table below may be considered as representative of the annual saving in maintenance, in connection with a station having established a first-class arc lamp department.

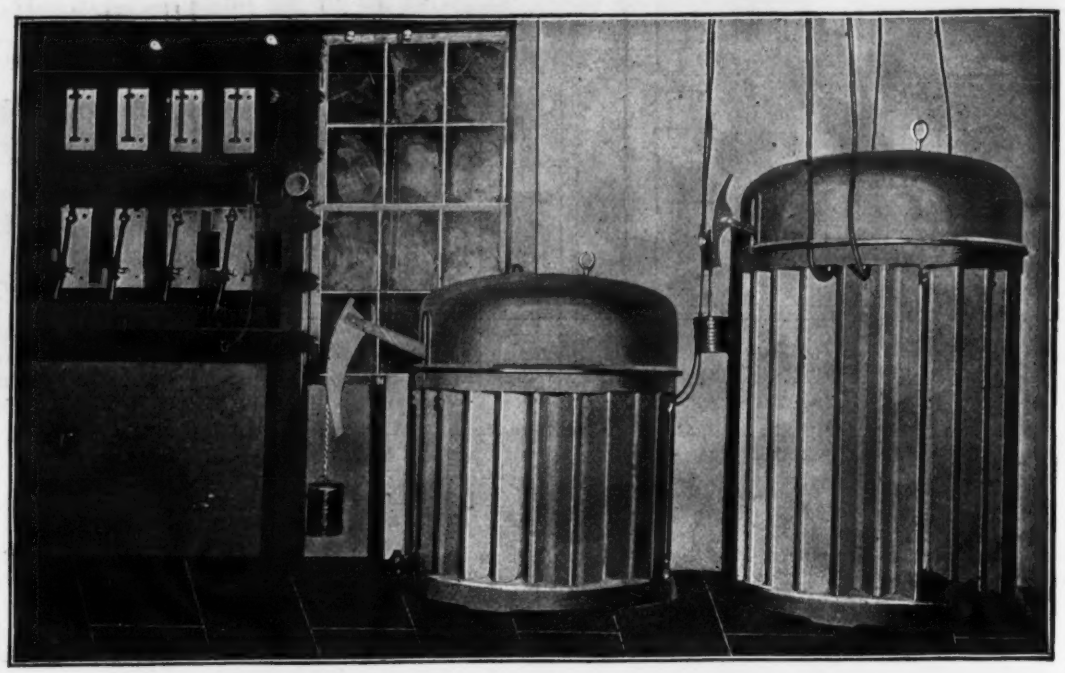


FIG. 1.—TRANSFORMERS FOR ARC LIGHTING, FORT PLAIN, N. Y.

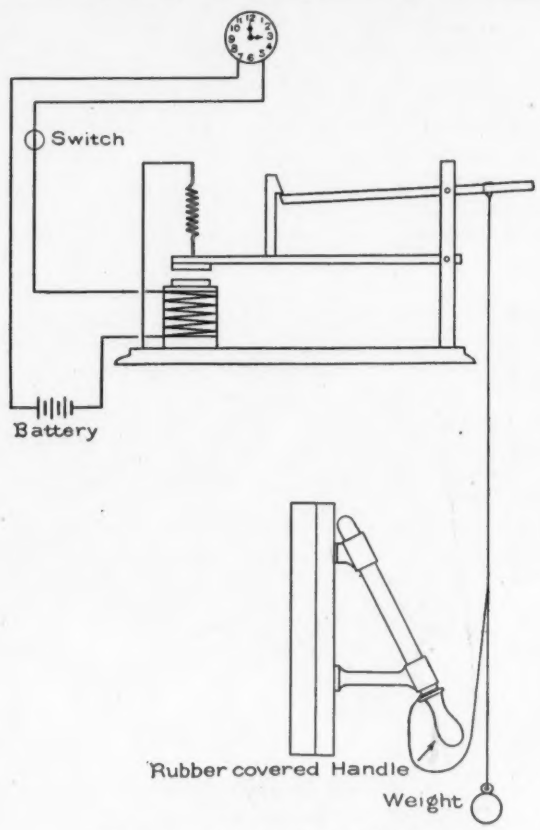


FIG. 2.—AUTOMATIC LAMP SWITCH.

Items.	Open arcs.	Enclosed arcs.
Trimming	$5.63	$1.28
Carbons	6.57	1.56
Inspector	.94	.90
Repairs	2.00	1.00
Inner globes	..	.60
Outer globes	.08	.14
	$15.22	$5.48
	5.48	
Annual saving in maintenance	$9.74	

Mr. Hillman states that nearly all of the 150 central stations which have adopted the series alternating system already, are using the standard 6.6-amp, or 425-watt lamp, showing a marked economy as against the old familiar 10-amp. open arc at 480 to 500 watts.

Exhibits at the Canadian Electrical Convention.

Several exhibits of electric lighting apparatus were made at the Kingston, Ont., convention of the Canadian Electrical Association last week. The City Hall, through the courtesy of the Council of the city, was used as an exhibition hall, and was taken advantage of by the Packard Electric Company, St. Catharines; the R. E. T. Pringle Company, of Montreal, Que., and the Hamilton Electric Supply & Construction Company, of Hamilton, Ont.

Mr. E. E. Cary, the manager of the Packard Company, together with Messrs. G. A. Powell, assistant manager; R. R. Wiley, of Chicago, expert electrician; William A. Turbayne, St. Catharines, arc lamp expert, and F. H. Leonard, Jr., Montreal, consultng electrical engineer, were on hand to exhibit the apparatus displayed and give information.

Associated with the Packard Company is the C. P. Company, Ltd., of St. Catharines, makers of arc lamps and supplies, their factory being located on the property of the Packard Company at St. Catharines; they manufacture all varieties of electrical supplies, as well as enclosed alternating and direct arc lamps and direct current series lamps; the trade-mark consists of the letters "C. P." enclosed within a diamond, C. P. being the abbreviation for "Canadian Product."

Closely allied with these interests is the Hamilton Electric Supply & Construction Company, of Hamilton, Ont., which has the exclusive agencies of the Packard and C. P. specialties for Hamilton and the districts through which the 23,000-volt transmission lines of the Cataract Power Company run.

Their combined display at Kingston consisted of a working exhibit of the Type "E" Scheefer recording wattmeters, showing their correctness on inductive and non-inductive loads, the inductive loads having power factor from .30 to 90 per cent; straight coils of the Type "L" transformers, which are now built solely with pancake coils, were shown from 1.5 kilowatt to 150 kilowatts. Various representative supplies of ninety odd varieties made by the C. P. Company were exhibited, including a full variety of their arc lamps.

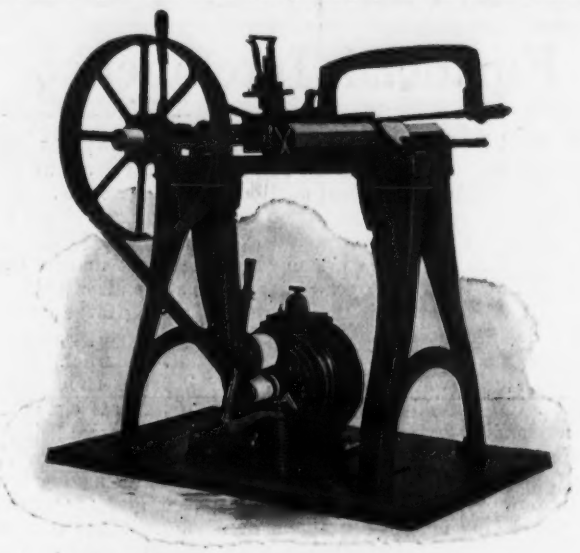
The hall was very tastefully decorated with flags, bunting and various-colored incandescent globes. In the centre of the hall was a fountain, upon and around which were interspersed electric globes and various varieties of plants.

Electric Hack Saw.

A convenient hack-saw outfit for blacksmith shops, or in any other place where steam power is not used, and for fully equipped machine shops, is shown in the accompanying illustration. The outfit shown consists of a No. 1 Q. & C. hack saw driven by an Emerson alternating-current motor, the connection between saw and motor being made by means of a belt.

These outfits are furnished by the Emerson Electric Manufacturing Company, St. Louis, with either the No. 1 or No. 2 Q. & C. hack saw and with motors suitable for any alternating current of usual voltage and frequency, and also for direct current, 110 volts and 220 volts.

The motor shown in the cut, which is the one furnished for current of 6000 to 8000 alternations per minute, is of unusually slow speed for an alternating-current motor, enabling the motor to be belted direct to the hack saw without the use of a countershaft. For current of a frequency higher than 8000 alternations, the speed of the motor would be greater, and, therefore, outfits made for high alternation circuits would be provided with a countershaft, enabling the hack saw to be operated at the proper speed, which is about 40 strokes per minute. The alternating-current motors furnished with these saws are built upon the induction principle, and have no brushes or

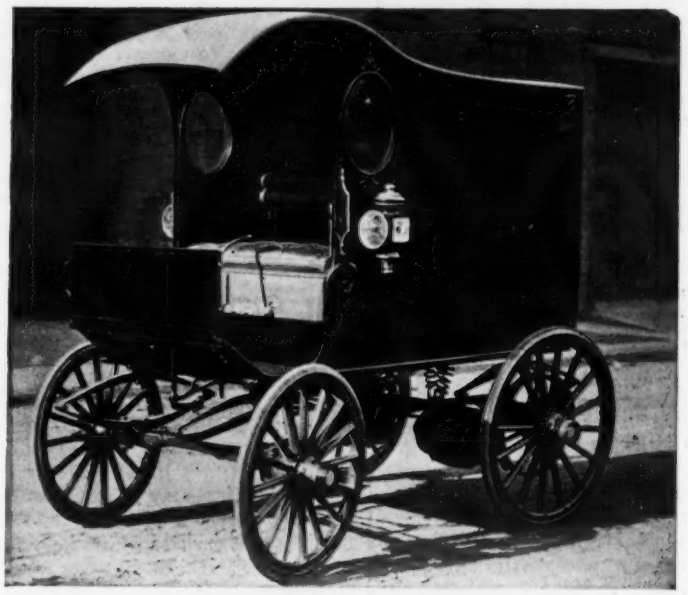


ELECTRICALLY DRIVEN HACK SAW.

commutator and no wearing parts except the bearings. Having no small wearing parts requiring renewal or adjustment, they will operate satisfactorily for years with no attention except occasional oiling.

New Electric Delivery Wagon.

We illustrate herewith a new delivery wagon just finished by Mr. Chas. A. Lindstrom, of the Hewitt-Lindstrom Motor Company, of Chicago. It weighs 3200 lbs., and has a radius of 50 miles on one charge. The maximum speed is 12 miles on 92 volts and 15 amperes.



ELECTRIC DELIVERY WAGON.

On the third speed, after running for two hours recently, the voltmeter read 92 volts. When traveling over macadam, it never takes more than 17 amperes, and the reading on a good road is only 15, which speaks well for the efficiency of the motors. Mr. Lindstrom claims an efficiency of 92 per cent. The vehicle is strongly built and, as will be noted, of trim and handsome appearance.

Rhode Island Clambake.

The twenty-second clambake tendered to the electrical fraternity by Mr. Eugene F. Phillips, general manager of the American Electrical Works, Providence, will take place on Thursday, Sept. 13 at the Pomham Club, already well known to electrical folk as the scene on many previous occasions of this delightful festivity. Lunch will be served at 11:30, and the bake opens at 2 p. m.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The inquiry for money is quiet and slow, time loans being quoted at 3½@4 per cent for 30 to 60 days, and 4¼@4½ per cent for longer arrangements. The rates for commercial paper are quoted on the basis of 4@4½ per cent for double names. Plenty of call money can be had at 2¼@2½ per cent. Dullness and heavy prices prevailed in the stock market owing to traders closing contracts over the three legal holidays beginning on Friday. It is evident that the disposition among large operators is to await definite indications regarding election results, and the public is taking no interest or part in the speculative market. Trading in Electrical stocks was fair, and, in general, prices show substantial advances. Of Brooklyn Rapid Transit 60,165 shares changed hands at prices ranging between 52½@53¾, the closing price being 55⅛, a net gain of 1⅞ over the closing quotation the week previous. Trading in General Electric was quiet, only 1270 shares having been sold. The quotations for the week ranged between 137¾@139, the latter being the closing figure—a net gain of 1 point. Three thousand and sixteen shares of the Metropolitan Street Railway were sold at prices ranging from 152½@154⅜, 154 being the closing price—1 point higher than that of the previous week. Western Union was quiet, the sales amounting to only 398 shares, while the price moved within a limit of a quarter of a point. The closing price—80—however, was five-eighths of a point higher than that of the previous week. The week for outside securities was the dullest of the summer. Few issues were traded in, and the generally stagnant condition was accentuated by the prospect of the triple holiday beginning Saturday. There were no marked features in the Electrical "outsiders," these stocks participating in the general dullness. The following list gives the closing quotations at New York, Boston and Philadelphia:

NEW YORK.

	Aug. 25.	Sept. 1.		Aug. 25.	Sept. 1.
Gen. Elec.	138	139	Elec. Veh.	16	16
Bklyn. Rap. Tran.	53¼	55⅛	Elec. Veh., pfd.	40	30
Met. St. Ry.	153⅜	154	Gen. Car.	6¾	5¾
Am. Tel. & C.	89	90	Ill. Elec. Veh. Tran.	1⅜	1¼
West. Un. Tel.	79⅜	80	N. Y. Elec. Veh. Tran.	7¼	7
Am. Dist. Tel.	..	25	N. E. Elec. Veh. Tr.	3¾	3¾
Com. Cable	164	164	Tel., Tel. & Co. of Am.	..	6
Elec. Boat	13	13	Hud. Riv. Tel.	..	..
Elec. Boat, pfd.	30	30	N. Y. & N. J. Tel.	..	163

BOSTON.

	Aug. 25.		Aug. 25.
New Eng. Tel.	123½	Erie Tel.	96
Mex. Tel.	..	Gen. Elec. pfd.	139
Westing. Elec.	46⅛	Am. Tel. & Tel.	..
Westing. Elec., pfd.	65	Ed. Elec. Lt.	..

PHILADELPHIA.

	Aug. 25.		Aug. 25.
Elec. Stor. Bat.	72	Phila. Elec.	2⅜
Elec. Stor. Bat., pfd.	90	Pa. Elec. Veh.	..
Elec. Co. of Am.	..	Pa. Elec. Veh., pfd.	..
Gen. Elec. Auto	¼	Am. Rys.	32

SALE OF BENEDICT-BURNHAM COMPANY.—The stockholders of the American Brass Company, otherwise known as the Brass Trust, have voted to accept the proposition for the purchase of the Benedict & Burnham Manufacturing Company. This move does away with a dangerous rival and incidentally causes an increase in the capital stock of the American Brass Company from $6,000,000 to $10,000,000. By the terms of the purchase each stockholder in the Benedict & Burnham Company receives for each share of his stock one and one-quarter shares American Brass stock, or, in other words, $125 par value American Brass stock in exchange for $25 Benedict & Burnham stock. This makes the total amount paid for the $400,000 par value Benedict & Burnham stock $2,000,000 par value American Brass stock. The capital stock of the American Brass Company had before this a capitalization of $6,000,000. By the stockholders' vote this was raised to $10,000,000 by the addition of $2,000,000 for the Benedict & Burnham purchase and $2,000,000 more which remains in the treasury at the disposal of the directors for future purchases.

FORT WORTH STREET RAILWAYS.—J. B. Coffenberry, head of the Coffenberry-Pishop Syndicate of Cleveland, Ohio, has purchased for himself and associates the two principal electric street railway lines in Fort Worth, the Fort Worth Street Railway and the City Street Railway. The two purchases approximate $400,000, and the plants have about 15 miles of well-equipped road. The same syndicate is at the head of the Dallas & Fort Worth Electric Street Railway, and has about a half-mile of track laid in the western suburb of Dallas. The line to Fort Worth, 32 miles in length, is to be pushed at once. The syndicate mentioned announce that they are ready to spend $1,000,000 in electric street railway enterprise in the vicinity of Dallas and Fort Worth.

PECKHAM TRUCKS.—Notice is given of the organization of the Peckham Manufacturing Company, of Kingston, N. Y., to manufacture motors, car trucks and wheels. Capital, $500,000. Directors: James H. Everett, V. B. Van Wagener and Hewitt Boyce, Kingston. This will take over the well known Peckham business.

DIVIDEND.—South Side "L," Chicago, has declared the usual quarterly dividend of three-quarters of 1 per cent. Local feeling is that South Side Elevated will increase the dividend to 4 per cent at the next annual meeting. Earnings justify it.

KNICKERBOCKER TELEPHONE MORTGAGE.—The Knickerbocker Telephone & Telegraph Company has filed a mortgage for $5,000,000 on all its property, franchises, telegraph and telephone lines in this city and elsewhere, that are built or to be built. The mortgage is in favor of the City Trust Company and is to secure an issue of 5000 gold bonds of $1,000 each, payable in 50 years, from Sept. 1, 1900, with interest at 5 per cent. The mortgage was executed by William H. Eckert and Arthur Phillips as president and secretary of the Knickerbocker Company.

MASSACHUSETTS ELECTRIC COMPANIES.—There has been renewed activity in Massachusetts Electric Companies' securities, the preferred advancing ½ to 76½, and the common stock 1¼ to 24¼. It is estimated that the company will show earnings in excess of 3 per cent for the common stock for the 12 months ending Sept. 30. It is believed in some quarters that the common stock will be placed upon a 2 per cent dividend basis early next year.

AM. STEEL & WIRE.—The significant statement is made that the Steel & Wire Company's net earnings in the six months ended July 1 amount to $6,300,000. Of this total, it is stated that $800,000 net were earned during the month of May, immediately following the cut in wire products. The half-yearly earnings would therefore be equivalent to the present dividends of 7 per cent on both common and preferred stock of the company.

PHILADELPHIA TROLLEYS.—The present stockholders of the Schuylkill Traction Company will probably subscribe for the greater part of the new issue of $750,000 common and $250,000 preferred stock.

Commercial Intelligence.

THE WEEK IN TRADE.—Favorable reports from the principal Western centres were received last week, indicating that the aggregate of business was large. In summarizing the conditions, Bradstreet's states that distributive trade increases as the vacation season wanes. In the iron and steel trade gain in tone and increased volume of sales are noted, although prices, except in few instances, harden slowly. Relatively the most quiet and least satisfactory conditions rule in the primary textile markets of the East, reflecting the backward state of next spring's business. Corn-crop advices are viewed as rather better because of the ending of the late dry, hot spell at the West. Cotton-crop conditions are still, however, only partially defined, and leading State authorities are quoted as predicting a short crop. Money still retains its ease, and a significant feature is the statement that Western country bank reserves are so large that no extraordinary demand on the larger centres for crop-moving purposes is expected. The steadiness of staple prices is a feature full of interest in the present quietness of trade. Sixty-three railroads report gross earnings for the third week of August of $9,118,125, an increase of 7.1 per cent over this week a year ago. Bradstreet's reports the number of failures for the week as 165 against 135 last week and 131 the corresponding week last year. R. G. Dun & Company compute the liabilities of the concerns failing for the month of August at $7,323,903.

EXPORTS OF COAL are of interest to the electrical and the mechanical engineer. Exports of coal from the United States during the year 1900 are likely to reach $20,000,000 in value, against $10,000,000 in 1896 and $6,000,000 in 1890. The figures of the Treasury Bureau of Statistics show that the exports of coal from the United States during the seven months ending with July, 1900, are 50 per cent in excess of those during the corresponding months of last year, and double those of the corresponding months of 1898. In the seven months ending with July, 1898, the exports of coal from the United States were 2,375,451 tons; in the same months of 1899 they were 3,006,082 tons, and in the corresponding months of 1900 they were 4,601,755 tons. During the period from 1890 to 1900 the exportation of coal from the United States has quadrupled, but the principal growth has been in the years 1898, 1899 and 1900. While this growth

is observable in the exports to all parts of the world, it is especially marked with reference to our exports to the American continents. To British North America the exports in the seven months of 1898 were 1,788,398 tons and in the seven months of 1900, 3,253,803 tons. To Mexico the exports in the seven months of 1898 were 243,938 tons and in the corresponding months of 1900, 415,834 tons. To Cuba the exports have more than doubled, being in the seven months of 1898 114,655 tons and in the seven months of 1900, 241,712 tons; while to Puerto Rico the exports increased from 2621 tons in the seven months of 1898 to 15,313 tons in seven months of 1900. To the Hawaiian Islands the exports of the seven months of 1899 were 10,381 tons and in the corresponding months of 1900 21,001 tons, thus more than doubling in a single year. To the Philippine Islands the exports in the seven months of 1898 were 4810 tons and in the seven months of 1900, 41,068 tons, or eight times as much in 1900 as in 1898. The experiments with American coal which the Europeans have made within the last two or three years seem to have proved successful, as the exports to Europe, which in the seven months of 1898 amounted to only 4507 tons, were in the corresponding months of 1900, 278,572 tons. Of this 187 tons went to the United Kingdom, 4028 tons to Germany, 77,047 tons to France and 196,950 to other European countries.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ending Aug. 22: Antwerp—29 packages electrical material, $2557; 6 cases electrical machinery, $374. Argentine Republic—159 packages electrical material, $6671. British West Indies—44 packages electrical material, $1249. Bremen—2 packages electrical material, $780. Brazil—142 packages electrical material, $6747. British East Indies—1 case electrical material, $72; 3 cases motors, $800. British Possessions in Africa—185 cases electrical material, $20,996; 10 cases electrical machinery, $1034. British Guinea—16 packages electrical material, $268. Barcelona—4 cases motors, $180. Chili—6 cases electrical material, $91. Cuba—17 cases electrical material, $1427. China—48 packages electrical material, $864. Central America—14 packages electrical material, $233. Dutch West Indies—5 cases electrical material, $66. Genoa—8 cases electrical material, $694. Hamburg—23 packages electrical material, $4891. Hayti—1 package electrical material, $50. Havre—192 cases electrical material, $15,787; 6 cases electrical machinery; $390. Japan—187 packages electrical material; $5070; 29 cases electrical machinery, $5690; 39 boxes motors, $8953. London—43 packages electrical material, $3733; 2 cases electros, $157. Liverpool—30 cases electrical machinery, $4243; 33 cases electrical material, $2450. Marseilles—17 cases electrical machinery, $2008; Mexico—14 packages electrical material, $1039; 1 case motor cars, $200. New Zealand—25 cases electrical material, $1203. Philippines—80 cases electrical material, $1608; 7 cases motors, $583. Preston—17 cases electrical material, $750. Peru—11 packages electrical material, $364. Southampton—31 packages electrical material, $2320. Siam—10 packages electrical material, $490. Uruguay—2 cases electrical material, $200. Venezuela—6 packages electrical material, $23; 2 cases motors, $45.

IRON CLAD RESISTANCE COMPANY.—The following announcement has been issued to the electrical trade by Messrs. R. H. Mansfield, president; A. W. Berresford, vice-president, and A. P. Manning, secretary and treasurer, of the company named: "The Iron Clad Resistance Company, of Westfield, N. J., desires to announce that on and after Sept. 1, 1900, it will cease to do business under this name. The Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., has purchased the company in its entirety and will hereafter, in addition to its complete line of 'open' type apparatus, manufacture the various types of 'enclosed' rheostats, theatre dimmers, etc., heretofore manufactured by this company, and the combined business will be conducted from the Milwaukee and Westfield factories by the Cutler-Hammer Manufacturing Company. The staff of the Iron Clad Resistance Company will be added to the present staff of the Cutler-Hammer Manufacturing Company. In assenting to the consolidation, this company believes it is acting in the interest of its customers and friends, as the Cutler-Hammer Manufacturing Company will then be in a position to supply most complete lines of both the 'open' and the 'enclosed' types of dynamo field rheostats, motor starters and controllers, all types of automatic rheostats, and also complete lines of theatre dimmers. A large stock of all types will be carried in the East ready for immediate shipment."

WESTERN UNION.—Vice-President Clowry, of the Western Union, says: "I think it would cost about $15,000,000 merely to construct and equip a telegraph system to connect the large cities of the United States. I base this estimate on the cost of the systems built by the different companies which have from time to time entered the field. Seven companies organized to compete with Western Union have failed of success, although they had but one competitor. A new company would have three competitors—Western Union, the Postal and the long distance telephone. Telegraph construction is becoming more expensive every year. The service for the government, for newspapers and for the public grows more exacting every year, and admits of no interruption or delay. If the Chicago Board of Trade enters directly or indirectly into a telegraph scheme it will encounter severe competition. We cannot get to an agreement with the Board of Trade because its terms are such that they could not be accepted by any responsible telegraph company."

THE GLOBE TELEPHONE MANUFACTURING COMPANY, of Philadelphia, manufacturer of the Globe automatic telephone switch, reports that it has recently put telephones in the following establishments: Vicente Portuondo Segar Factory. Philadelphia, 7 telephones; International Printing Company, Philadelphia, 4 telephones; S. Morgan Smith Company, York, Pa., 9 telephones; L. Dannebam's Sons & Company, Philadelphia, 5 telephones; Ivins, Dietz & Magee, Philadelphia, 8 telephones; MacCalla & Company, Philadelphia, 4 telephones; Farr, Bailey Manufacturing Company, Camden, N. J., 14 telephones; the Argo Mills Company, Gloucester, N. J., 13 telephones; Henry H. Roelofs & Company, Philadelphia, 8 telephones; Thomas Martindale, Philadelphia, 7 telephones; Henry H. Altemus & Company, Philadelphia, 10 telephones; Childs' Dining Room Company, Philadelphia, 11 telephones. The Globe Telephone Manufacturing Company has also opened a branch office at 430 Walnut Street, Philadelphia.

NEW APPARATUS FOR SCRANTON, PA.—Excavations are now being made for an addition to the Washington Avenue Station of the Suburban Electric Light Company, of Scranton. The new building is to be 80 ft. by 120 ft. The new machinery to be installed will comprise nine boilers—six return tubular and three locomotive type—each of 125 horse-power, to feed three 300-hp engines—one Greene and two Dickson—which will be run non-condensing, as is the remainder of the plant. The electrical equipment will include six 125-light, two-circuit Brush arc machines and one 6000-light alternator. The coal supply for the plant now in operation is such as is encountered only in the coal regions. The plant was erected in proximity to a culm pile, which is nothing more than the slate and slack of the mine, the shaft of which is not over 300 ft. distant from the plant.

EQUIPPING A SEWING MACHINE FACTORY.—The new shops of the Singer Manufacturing Company, at Elizabethport, are about ready. They are to be equipped with electric motors, which are being installed on each floor. This work will entail the addition of a new power plant, and several Ball & Wood engines have been purchased. Babcock & Wilcox boilers will furnish the additional steam. The electric motors have been purchased from the Diehl Manufacturing Company. It is said that if the application of electric power in this building proves successful the entire plant will be rearranged to be driven by electricity from a central power plant.

CRANES FOR VENICE.—Advices from Venice, Italy, state that the contract for six electric cranes for the harbor authorities of that city, was awarded to Schuckert & Company, of Nuremberg. The bids received for the American cranes were all through German and British machinery firms. It is argued that if the American manufacturers had had direct representatives in Italy, in all probability the contract would have been awarded to them. The fact that in Southern Europe Americans are represented through foreign concerns who are far more eager to sell their own manufactures, places the Americans at a disadvantage.

FREIGHT SCHEDULES.—The Merchants' Association, on advice of its counsel, will commence suit against one of the Southern railroads, represented on the Southern classification committee, before the Interstate Commerce Commission, in order to test the legality of the rates under classification No. 27, a revised edition of which went into effect June 1. This classification advanced rates on about 1,700 articles, and there have been many ineffective protests against it. The proposed action will result in a legal determination of the disputed question as to whether or not the rates are reasonable and just.

THE CAPITAL POWER COMPANY, of Ottawa, Ont., has been formed to take over and develop the Conroy electric plant at Deschenes Rapids, a few miles from Ottawa. This plant already brings in $33,000 yearly revenue, and the expense of operating it is only $9,000 per annum at present. The company's new power house at Deschenes is furnished with modern turbines, made by the Trump Manufacturing Company, of Springfield, Ohio. The flumes are made of concrete and the buildings are fireproof, the whole being a good example of a modern, up-to-date power house.

POLES FOR EXPORT.—The Electric Railway Equipment Company, Cincinnati, has closed contracts within the last two weeks for several orders of poles for export; one contract amounted to $78,000, another $29,000 and another is on the tapis for closing within the next ten days. This company reports domestic orders in this country for poles and line material and other goods for August amounting to over $50,000. Manager McCallum believes that there is going to be a phenomenal amount of electric railroad building done in this country and abroad within the next year.

General News.

Decision in Favor of the Tesla Rotating Magnetic Field Patents.

As announced in these pages last week, Judge Townsend in the U. S. Circuit Court for the District of Connecticut has handed down a decision sustaining three broad Tesla patents—Nos. 381,968, 382,279 and 382,280—of May 1, 1888, in the suit of the Westinghouse Electric & Manufacturing Company against the New England Granite Company, which had been using a Cushman phase motor operated from a General Electric three-phase generator. The case was reviewed at considerable length in the ELECTRICAL WORLD AND ENGINEER of Nov. 18, 1899, when the chief points in contention were brought out. The full text of the decision has now been handed down, which follows closely the lines then noted.

The claims in issue in patent No. 381,968 are as follows:

"1. The combination, with a motor containing separate or independent circuits on the armature or field-magnet, or both, of an alternating-current generator containing induced circuits connected independently to corresponding circuits in the motor, whereby a rotation of the generator produces a progressive shifting of the poles of the motor, as herein described.

"3. The combination, with a motor having an annular or ring-shaped field-magnet and a cylindrical or equivalent armature, and independent coils on the field-magnet or armature, or both, of an alternating current generator having correspondingly independent coils, and circuits including the generator-coils and corresponding motor-coils in such manner that the rotation of the generator causes a progressive shifting of the poles of the motor in the manner set forth."

That of patent No. 382,280 is as follows:

"1. The method herein described of electrically transmitting power, which consists in producing a continuously progressive shifting of the polarities of either or both elements (the armature or field-magnets or magnets) of a motor by developing alternating currents in independent circuits, including the magnetizing coils of either or both elements, as herein set forth."

The claims in issue of patent No. 382,279 are as follows:

"1. The combination, with a motor containing independent inducing or energizing circuits and closed induced circuits, of an alternating-current generator having induced or generating circuits corresponding to and connected with the energizing circuits of the motor, as set forth.

"2. An electro-magnetic motor having its field magnets wound with independent coils and its armature with independent closed coils, in combination with a source of alternating currents connected to the field coils and capable of progressively shifting the poles of the field magnet, as set forth.

"3. A motor constructed with an annular field magnet wound with independent coils and a cylindrical or disk armature wound with closed coils, in combination with a source of alternating currents connected with the field-magnet coils and acting to progressively shift or rotate the poles of the field, as herein set forth."

The complainant's theory of the invention was that the gist of it was the utilization of the alternating currents generated by an alternating-current dynamo or generator for effecting such shifting of the magnetic poles or resultant attractive forces upon the armature of a motor, and thus causing such armature to rotate in response thereto. His broad invention was the production in a motor of a progressively shifting magnetic field (or pole) by means of two or more independent alternating currents, differing in phase, and circuits which preserve the independent character and phase relation of such currents."

By way of defence, the decision goes on, the defendants relied upon four prior publications, namely, the Baily article of 1879; the Siemens patents of 1878; Deprez's article of 1880-4, and the Bradley application of May 9, 1887. As to Baily the court says: "Baily merely showed how to apply a series of successive impulses to the disk by an intermittent rotation of the field and thus produce Arago's rotation field with stationary magnets instead of a moving magnet, and he showed how the motion of the disk could be reversed. He conceived the idea of a uniform rotation by a manifestly imposible and impracticable construction. He did not claim to have established a continuous rotating field or to know any way in which a uniform rotation could be produced. He did not use alternating currents, but reversed currents. He was not dealing with the subject of the transmission of power. Defendants' expert admitted that his paper merely describes a laboratory experiment."

As to the allegation that the Siemens patent of 1878 was an anticipation, the Court says: "This patent is chiefly for means to convert motive power into electricity. It does not specificaly relate to or describe or fully show a system of apparatus for the transmission of power. It not only fails to refer to any difference of phase, or to point out how the armature and overlapping coils are to be coupled together to produce such phase, but it repeatedly describes the use of commutators in order to create a continuous or direct current. At this date it was not known that an alternating current machine could be used as a motor. Motors then were operated only by a direct or continuous current so far as the record shows. The 'suitable modifications' to change this machine into a motor are nowhere described; in view of the repeated reference to commutators, the modifications must be presumed to relate to such continuous current machines; and in view of the then state of the art such suitable modifications would have required such a series of experiments and such a departure from the existing theories and such development and application of devices in unexpected and non-analogous ways as would in themselves have constituted invention. Siemens himself, as late as 1884, and Alteneck, the other inventor of said Siemens patent, in 1881, admitted that they did not know that alternating currents could be used as motors. This evidence was objected to on the ground that the publications containing said statements are not duly proved, but the fact is established by other sufficient evidence."

The Court then takes up the Bradley application filed six months before the Tesla application, but regards it also as inadequate. "The single specific object of Bradley's construction stated in said specification was to obviate 'difficulties and limitations' in prior constructions wherein the machine was idle during a part of the time. He suggests that this may be done by rectifying one of the alternating currents by a commutator and then combining the two or by connecting each with a separate circuit. He does not show how he would use them in the latter case to operate a motor, nor did he indicate any combination of the alternate currents for a single motor or show that he had any conception of their use, if at all, otherwise than separately in single-phase motors.

"A comparison of the Bradley application prior to Tesla with the Bradley patent, issued subsequent to Tesla, shows that in the former he described a method and illustrated an apparatus designed to obviate the objections to a two-phase alternating currrent by combining both currents in one by means of a transformer, while from the latter he omitted this description and method and inserted figures which, while strikingly suggestive of the apparatus shown by Tesla, failed to show that he conceived the Tesla idea or sought to secure the object of Tesla's invention. For this reason, and further because Bradley's application is limited in scope, and ambiguous and indefinite; because it fails to show that he had any conception of the Tesla idea of 'the utilization of the motor for the purpose of progressively shifting the magnetic poles of a plurality of alternating currents by circuits which preserved the independence and differing time relation of their phases;' because, even if the idea had been first conceived by Bradley, it was not sufficiently described to disclose the principle or method of operation; because Tesla was the first to reduce this principle to practice, Bradley does not anticipate or limit."

As to the publications of Marcel Deprez of 1880-84, the Court concedes that Deprez not only disclosed the principle which Tesla utilized, but he gave a mathematical demonstration of the rotating field. But the only device possible to Deprez's mind was an electric compass. "All that Deprez demonstrated, therefore, was that if a field was made in which the field magnet varied relative to the brushes, or *vice versa*, the angle of variation would be indicated by the needle in another machine which would move quickly or slowly as the brushes and magnets shifted relative to each other and would indicate the new angle subtended between the brushes and the magnet. The only useful, practical application of this device was to attach it to a machine which would produce currents, and to use the earth or a ship to indicate the shift of position by means of a needle on top of the mast. This apparatus failed to teach any one that alternating currents could be used as a source of power in a motor. It was a mere indicator. It did not involve the utilization of two alternating currents differing in phase as a source of power in producing a continuous magnetic field. It did not depend upon any constant, regular, progressive currents, and, so far as the evidence shows, it was like the apparatus of Baily, confessedly a mere laboratory experiment. That Deprez did not conceive of the Tesla idea of utilizing regular, progressive, constant alternations of current is conclusively shown by his own statement in 1884 after the publication of this paper and after the invention of the Gaulard and Gibbs alternating current systems for lighting, when he published another paper in which he criticised the system and stated that one of the most serious objections to it was that it was not applicable to the transmission of power and adds: 'I must further remark that alternating currents are of no use in the transmission of power; they are suitable only for lighting purposes.' In fine, the evidence shows that, as Prof. Sylvanus Thompson says in his work on this general subject: 'Deprez's theorem bore no fruit; it remained a geometrical abstraction.'"

Judge Townsend then reviews the state of the art up to the time of Tesla's invention, and says that prior to it no alternating-current motors were in use, although there was an urgent demand for them. Six months later Tesla read his paper before the American Institute of Electrical Engineers and announced that previous efforts to utilize alternate currents had failed; that he had brought forth a novel system for the tarnsmission of power, and explained its theory and demonstrated its operation by exhibiting a working motor; and no one of the electricians present questioned his claim or criticized his apparatus.

Tesla first stated the discovery how these alternations could be thus utilized and showed the machine and method adapted for this purpose. He is entitled to a patent for this discovery as were the discoverers of the use of anthracite coal instead of bituminous coal, or of the hot blast instead of the cold blast, in the manufacture of iron, or of the practical application of electricity to the telegraph or telephone. Judge Blatchford once sustained a patent for insulating electric wires by means of gutta-percha, and said:

"The gist of the invention is the discovery of the fact that gutta-percha is a non-conductor of electricity, and the application of the fact to practical use. The claim is valid, even though a metallic wire covered with gutta-percha existed before the plaintiff's invention, if it was not known that gutta-percha was a non-conductor of electricity, and could be used to insulate the wire."—Colgate vs. Western Union Telegraph Company, 6 Fed. Cases, 86.

It is not necessary to go to this extent in sustaining these patents. The complainant may safely rest its case on the general principles laid down in the various decisions of the Supreme Court and extended and developed in Potts vs. Creager, *supra*.

Further than this, the Court says: "But if the evidence already considered be disregarded and it should be assumed that alternating and alternated currents were theoretically known equivalents, even then the argument of counsel for defendants does not appear to be sound. They contend that a superior result, by reason of the substitution of one known equivalent for another, does not constitute invention. But the first substitution or application of such theoretical equivalent to produce a new or non-analogous or unexpected result may involve invention. Tesla applied the alter*nating* current to do what the alter*nated* current had never before done, namely, to produce a new, unexpected and practical system of transmision of power. A careful study of the evidence has led to the conclusion that Tesla made a new and brilliant discovery. But even if this be incorrect, it is proved that by a new combination and arrangement of known elements, he produced a new and beneficial result never attained before. The technical defense of non-infringement by reason of the fact that defendants use only a motor, and that there is no allegation or proof of con-

spiracy with the owners of the plant which supplies the power, was not pressed on the argument, and as six days were spent in the discussion of the questions on the merits this point will not be discussed. If any amendment is necessary to cover these points it should be allowed. The contention of defendants that Tesla does not describe an operative machine is not satisfactorily proved. It is proved that in fact various practical motors have been manufactured according to his invention."

The question was urged by the defence as to the point that "independent" in the patents meant separated or "isolated." The Court held that "the claims, confessedly, cannot be read as requiring isolation of the circuits, but at most only such independence as is necessary for the purpose of producing a rotary field; that is, the connections must be such as not to interfere with the independency of the circuits which operate to shift the poles. The only practical result from defendants' use of three conductors instead of six is an improvement 'to regulate the action of the motor,' which result was anticipated by Tesla, and it is proved that it was known in the prior art that one of these arrangements was a substitute for the other. Inasmuch as the defendants have not invented any new idea, but have adopted an old contrivance which performs the same result in substantially the same way by a formal and unsubstantial change in means, and by circuits which while in some sense interdependent are operatively independent, and which preserve and utilize the vital element, independence of phase, these circuits must be held to be the equivalents of the independent circuits of the patent, the word independent being interpreted to mean *comparatively independent*, so as to embrace the true spirit and essence of the Tesla invention.

"This conclusion is supported by a great number of illustrations of similar uses of such independent conductors in the general field of the arts. As the expert for complainant has pointed out, in railroads, cash carriers, electric telegraphs, the tracks, the earth or a single wire, will serve as common but independently acting conductors. It does not seem necessary to further discuss this contention based on a technical verbal distinction. Defendants' three wires are operatively independent; they are actually independent while in action; they are independent enough to do the required work."

The Court touched briefly on the action of the Imperial Court of Germany presumed to affect adversely the Tesla patents, but saw no sufficient reason why the conclusion of that court should have any bearing on the question of infringement here.

Infringement of the first claim of patent No. 381,968 necessarily implies infringement of the method patent No. 382,280. The finding that the circuits of the defendants are independent, in the sense of the Tesla patents, is decisive against the defendants as to the infringement of the first and second claims of patent No. 382,279; and the field magnet of defendants' motor, while differing in some respects from that of the third claim of No. 381,968, is annular or ring-shaped within the meaning of said claim and infringes it.

The decision concludes as folows: "The search lights shed by defendants' exhibits upon the history of this art only serve to illumine the inventive conception of Tesla. The Arago rotation taught the school-boy 50 years ago to make a plaything which embodied the principle that a "rotating field could be used to rotate an armature." Baily dreamed of the application of the Arago theory by means of a confessedly impossible construction. Deprez worked out a problem which involved the development of the general theory in providing an indicator for a ship's compass. Siemens failed to disclose the "suitable modifications" whereby his electric light machine might be transferred into a motor, and Bradley is almost equally vague. Eminent electricians united in the view that by reason of reversals of direction and rapidity of alterations an alternating current motor was impracticable, and the future belonged to the commutated continuous current. It remained to the genius of Tesla to capture the unruly, unrestrained and hitherto opposing elements in the field of nature and art and to harness them to draw the machines of man. It was he who first showed how to transform the toy of Arago into an engine of power; the "laboratory experiment" of Baily into a practically successful motor; the indicator into a driver; he first conceived the idea that the very impediments of reversal in direction, the contradictions of alternations might be transformed into power producing rotations, a whirling field of force. What others looked upon as only invincible barriers, impassable currents and contradictory forces, he seized, and by harmonizing their directions utilized in practical motors in distant cities the power of Niagara.

"A decree may be entered for an injunction and an accounting as to all the claims in suit."

Messrs. F. H. Betts, Kerr, Page & Cooper, and L. E. Curtis, on the brief, appeared for the complainant; and Mitchell, Bartlett & Brownell for the defendants.

THE TELEPHONE.

WHEELING, TEX.—The National Telephone Company has been granted a telephone franchise.

DALLAS, TEX.—Aubrey & Smith have asked for a franchise for the construction of a telephone system.

LANSING, MICH.—The Oakland County Telephone Company has been organized at Pontiac with a capital stock of $50,000.

FALLS CHURCH, VA.—The Falls Church Telephone & Telegraph Company contemplates the extension of its line to Leesburg, Va.

MEMPHIS, TENN.—The Cumberland Telephone & Telegraph Company is now at work on the construction of conduits for its underground system.

EL PASO, TEX.—The Independent Telephone Company, capital $51,000, has been chartered. Incorporators: J. S. Dodge, T. B. Dockery and Mark Muler.

ELORA, TENN.—A new telephone line has been strung from Huntland to this place, giving Elora connection by telephone with Chattanooga, East Tennesee and North Carolina.

BEAUMONT, TEX.—O. L. Brailey and C. T. McCreary, of San Antonio, and P. N. Millard, of Beaumont, have organized a company and applied for a telephone franchise.

MONTICELLO, N. Y.—The Monticello Telephone Company has been incorporated. Capital, $2,000. Directors: Martin La Tourette, F. H. Strong and D. S. Yeoman, Monticello.

GADSDEN, ALA.—The Alabama & Georgia Long Distance Telephone Company is building a line from Gadsden to Birmingham, and will build one from Anniston to Talladega.

HENRIETTA, N. Y.—The Farmers & Merchants' Telephone Company has been incorporated. Capital, $1,200. Incorporators: J. D. Stine, A. C. Thompson, W. B. Worsham, all of Henrietta.

GREELEY, COLO.—The Greeley Independent Telephone Company has been incorporated. Capital, $10,000. Incorporators: A. W. Trenholm, B. F. Johnson, J. E. Neill, G. F. Shear, all of Greeley.

SPRINGFIELD, ILL.—The Adams County Telephone Company, of Camp Point, has been incorporated. Capital, $5,000. Incorporators: George W. Cyrus, Charles M. Henry, Orville H. Lawless.

MULBERRY GROVE, ILL.—The City Council of this place has granted a 20-year franchise to John Kurtz, of Vandalia, Ill., to put in a telephone system. The system is to be completed within 30 days.

BRAZIL, IND.—S. R. Markle, representing the Clay County Telephone Company, was granted a 20-year franchise for an exchange in this city, the wires in the central part of the city to be placed underground.

OKLAHOMA, OKLA.—The Citizens' Telephone Company has been incorporated with a capitalization of $60,000. The incorporators are: W. S. Reese, Salina; R. S. Hayes, Geo. Spencer, Thomas McMechan and A. C. Root.

GALESBURG, ILL.—The College City Telephone Company, of Galesburg, has been incorporated for $25,000. Incorporators: J. L. Hooper, George A. Lawrence and G. P. Williams. Its object is to operate a telephone line.

ALBANY, N. Y.—The Springville Telephone Company., of Springfield, has been incorporated. Capital, $3,000. Incorporators: M. N. Brooks, F. D. Smith, A. A. Churchill, all of Springville; I. W. Smith, attorney, Springville.

ST. PAUL, MINN.—The Kandiyohi County Telephone Company, of Willmar, has been incorporated. Capital, $10,000. Incorporators: P. J. Haley, A. F. Hansom, J. M. Spicer, all of Willmar; J. O. Lundberg, of Svea; H. B. Eddy, of Whitefield.

ABERDEEN, MISS.—The Independent Telephone Companies of this State will hold a meeting on Sept. 19 for the purpose of organizing a State association. Messrs. C. W. Bolton, of Pontotoc, and L. B. Camp, of Amory, are at the head of the movement.

COLUMBUS, GA.—The new Independent Telephone Company will be in operation here soon. The Bell Company tried to forestall opposition by putting in a new outfit, but the new Independent Company secured all the subscribers it wanted without trouble.

POINT PLEASANT, WEST VA.—The Mason County Telephone Company, of Point Pleasant, has been incorporated. Capital, $25,000. Incorporators: F. B. Tippett, E. J. Mossman, both of Point Pleasant; F. A. Stemple, F. J. Spencer, C C. Handy, all of Wauseon, Ohio.

SPARTANSBURG, S. C.—The Citizens' Telephone Company, of Spartansburg, S. C., has reorganized with a greatly increased capital and steps are being taken for thoroughly equipping its present plant. A new switchboard and 6000 ft. of cable have already been ordered.

MILWAUKEE, WIS.—The Farmers' Telegraph Construction Company has been incorporated in Milwaukee with a capital of $500,000. This is the same enterprise, with an enlarged capitalization and a change of name, which was formerly the Central Telegraph & Telephone Company.

WARSAW, IND.—With a capital stock of $60,000, the Commercial Telephone Company has just filed articles of incorporation, having purchased from the Warsaw Telephone Company its local system and all its toll lines, which connect 48 cities in Indiana. The incorporators are: Strauss Bros., Ligonier, Ind.; John D. Widaman, Odell; C. W. Burke, Silas W. Chipman, Charles E. Wahl and Mel R. Williams, of Warsaw, Ind.

COLUMBUS, OHIO.—The new long-distance line of the United States Telephone Company, connecting the exchange in this city with those in Lancaster and Logan, has been placed in operation. Later this line will be extended to Nelsonville, Athens, Parkersburg and Marietta. Work has been started on a long-distance line from this city to Springfield. In Fairfield County the company has established branch lines and toll stations in Amanda, State Farm, Sugar Grove, Millersport, Pleasantville, Clearport and other towns.

CHARLOTTE, N. C.—Contracts have been signed by the Interstate Telephone & Telegraph Company to connect its system with that of the Long Distance Telephone Company of Virginia. The Interstate Company has exchanges in all North Carolina towns except one. About 350 miles of line will be constructed by the Interstate Company in Virginia, giving a total of 700 miles in that State. The North Carolina line has been completed. The two lines will be connected at Danville, Va.

LOUISVILLE, KY.—A million dollar independent telephone company has been organized here. An ordinance was introduced in the General Council to grant a franchise to this company on a very low basis of charges. E. M. Coleman is the representative of the new company, which, he says, is ready to be incorporated with $1,000,000 of stock. It is to be known as the Louisville Independent Home Telephone Company. He says that an exchange and a telephone system, to cost $450,000, will be built in Louisville, and that the remainder of the capital will be devoted to building up independent lines in the State.

CHICAGO, ILL.—The Exchange Telegraph Company has a capital of $5,000,000 to start with, and will be used chiefly for grain business between the leading exchanges. A committee has been at work on the organization of the company and the construction for three weeks. Its work has been performed chiefly by a committee of five, of which A. O. Slaughter is chairman. The other members are John R. Walsh, president of the Chicago National Bank; P. A. Valentine, confidential man for P. D. Armour; Charles Counselman, the elevator man, and John F. Harris, the commission man. Ben Bryan is secretary of the committee of eleven. Figures have been secured giving the cost of constructing a 10-wire copper line at $600 per mile. A line of this character between Chicago and New York will cost, according to the estimates, $1,000,000.

ELECTRIC LIGHT AND POWER.

BRANDON, MAN.—The Brandon Electric Light Company has been given authority to increase its capital from $50,000 to $125,000.

KIRKWOOD, MO.—The Board of Aldermen on Sept. 1 received and opened bids for bonds to the amount of $17,000 for the purpose of erecting a municipal electric lighting plant.

KINGSTON, ONT.—The City Council of Kingston, Ont., will take steps to acquire the electric light plant of the Kingston Light, Heat & Power Company, or in the alternative to install a new electric light plant.

MORRISBURG, ONT.—This town is inviting tenders for the erection of an electric lighting and power plant, to include three distinct sections: hydraulic development and building, water wheels and steam works,, and electric plant.

HAMLET, S. C.—It is stated that the Compress Company of this place has contracted with the Seaboard Air Line to furnish the former with 40 arc and 700 incandescent lights, thus necessitating the installing of a large plant.

WASHINGTON, D. C.—The supervising architect of the Treasury Department will receive proposals until 2 o'clock P. M. Sept. 11 for the installation of the wiring system for the United States Bureau of Engraving and Printing at Washington. Mr. James Knox Taylor is supervising architect.

ST. LOUIS, MO.—The Missouri Edison Electric Company got a temporary injunction Aug. 27 against the St. Louis Transit Company to restrain the latter from laying tracks over or on both sides of a manhole on the corner of Broadway and Locust Streets. The transit company was putting in a switch to connect the Broadway and Locust Street tracks.

YOUNGSTOWN, OHIO.—A deal that has been pending some time whereby New York and Chicago capitalists will acquire control of the Youngstown Gas & Electric Light Company was consummated a few days ago, the purchase price being approximately $500,000. It is understood that the new owners will undertake to acquire the Kearcher lighting plant, an independent concern; the projected steam heating plant, and several interurban electric railways now under construction or projected in this vicinity.

WASHINGTON, D. C.—The Navy Department has been notified by the Westinghouse Electric & Manufacturing Company that the machinery for the electric power plant to be installed at the New York Navy Yard is ready for delivery. The contract for this plant was let about a year and a half ago, and when the apparatus is installed the New York Navy Yard will be first in the country to be fully equipped with electric power for the driving of machinery and machine tools. The entire power plant will represent an outlay of nearly $1,000,000.

CARLINVILLE, ILL.—The city of Carlinville has closed a contract for lighting the city by electricity for the ensuing 10 years with W. L. Mounts, paying $62.50 per year for each light, and contracting for 47 lights. They will be the enclosed style. The contract gives the city the privilege of purchasing the plant if desired at the expiration of any two years during life of same. A 40 x 40 brick building is now being built for the new plant, in which will be installed a 90-hp boiler and engine, and a dynamo of 75-light capacity. The new contract will begin Oct. 15.

RED BUD, ILL.—Injunction proceedings have been instituted in the Circuit Court to restrain the City Council from issuing $7,000 bonds. The council at its last meeting appropriated $10,000 for the purpose of erecting an electric light plant to be owned and operated by the city. To raise this amount the council authorized the issuance of city bonds and provided that a direct tax be levied to meet the interest on the bonds and to provide a sinking fund from which to pay the bonds when they become due. The proposition to establish an electric light plant was submitted to the voters at the April election and was carried by 10 majority.

ATLANTA, GA.—Ford, Bacon & Davis are carrying out some very extensive improvements for President H. M. Atkinson, of the Georgia Electric Light Company, of Atlanta. In the reconstruction of the lighting station the present return tubular boilers will be replaced with 2150-hp Babcock & Wilcox water tube boilers with economizers. Two 1500-hp Rice & Sargent cross compound condensing engines, or a total of 3000 horse-power, will be added to the two present Green engines and one McIntosh & Seymour, giving a total rated engine capacity of 5350 horse-power and a maximum overload capacity of 7200 horsepower. To one of the Green engines will be belted a 600-kw alternating-current generator, and to the two new engines each one 1000-kw alternating-current generator, giving a total rated A. C. capacity of 2600 kilowatts and a maximum overload capacity of 3600 kilowatts. In addition there is 900 kilowatts rated capacity of D. C. railway generators capable of 1100 kilowatts maximum overload capacity. There will be provided a complete duplicate high-pressure steam piping system and central condensing system, together with all of the necessary steam accessories. A 25-ton electric traveling crane will be installed in the engine room; also the main switchboard and electrical connections. There will be located on Alabama Street, in the centre of the business district, a sub-station and office building, containing 1500-kw of step-down transformers and 1200-kw of rotary converters, with switchboard and necessary apparatus. There will also be located at this point a storage battery of 150 cells of 2720 amp-hours capacity at one-hour rating. From this point all of the current used within the fire limits of Atlanta will be distributed. The present series open arc lighting system will be replaced by a new series alternating-current distribution system complete, with new enclosed lamps and constant current transformers. The present A. C. incandescent light and D. C. motor distribution systems in the central part of the town will be replaced by an Edison three-wire D. C. distribution system operated from the sub-station. Within the fire limits all of the electrical conductors will be placed underground in tile conduits, having a total length of 35 miles with underground service connections. While the present engine and generating capacity is barely adequate to handle the load now on the system, which in 16 candle-power equivalent amounts to 64,248 lamps, the new machinery in connection, with the storage battery, will take care of a connected load of approximately 100,000 lamps, 16 candle-power equivalent, or an increase of 55 per cent.

THE ELECTRIC RAILWAY.

MICHIGAN.—The Railways Company General has had 16 new cars constructed for the Michigan Traction system, and two for the Elmira Company.

JACKSON, MISS.—It is reported that the Jackson Street Railway has decided to build a further extension during the present year.

ATLANTA, GA.—The Atlanta Railway & Power Company has applied for a franchise to extend its line on Washington and several adjacent streets in the city.

ST. LOUIS, MO.—A meeting of stockholders of the Labor Union Street Railway Company will be held Oct. 29 to vote on the proposition to increase the capital from $5,000 to $3,000,000.

SHERMAN, TEX.—Messrs. Crearar & Fitch, projectors of the Denison & Sherman Interurban Railway, have purchased a tract of land to be used as a park and site for the power plant.

LANCASTER, PA.—The Lancaster, Mechanicsburg & New Holland Electric Railroad Company has leased for 999 years the New Holland Turnpike Company, 13 miles in length. A trolley road will be built on the turnpike.

ELIZABETH, N. J.—The Elizabeth Street Railway Company and the Elizabeth city horse railroad, which were recently secured by the Riker-Hine Syndicate, will not be put under the new management until December, and will be operated as at present until then.

WHEELING, W. VA.—The Northern Ohio Electric Company, which will build a trolley line from this city to Wellsburg, W. Va., has organized permanently. Howard Hazlett was elected president; John G. Welty, vice-president, and John Arbenz, secretary and treasurer.

DUBUQUE, IOWA.—The Union Electric Company, of Dubuque, has been incorporated to build an electric railway. Capital, $1,000,000. Incorporators: E. D. Stout, W. S. Molo, G. W. Kiesel, E. A. Engler, W. J. Brown, D. D. Myers, B. W. Lacy, B. E. Linehan, all of Dubuque.

ST. LOUIS, MO.—The Madison Construction Company filed articles of incorporation Aug. 25. Its capital stock is $25,000. Edwin H. Gorse, F. W. Watkins, Theodore F. Meyer and A. H. Smith are the incorporators. The company's purpose is to build railroads, roads, streets and electric plants.

BOSTON, MASS.—The various street railway lines running out to Marlboro have been bought in the interest of the Boston & Worcester Street Railway. The franchise of the company has been extended, and the lines will be built into Boston as soon as arrangements can be made regarding terminals here.

PARKERSBURG, W. VA.—The Fairmount & Clarksburg Electric Railway Company has been incorporated. Capital, $100,000. Incorporators: J. N. Camden, S. D. Camden, I. H. Davis, all of Parkersburg; H. R. Preston, of Baltimore, Md.; J. A. Fickinger, of Monongali; J. N. Camden, attorney, Parkersburg.

EL PASO, TEX.—The El Paso & Juarez Traction Company has received a concession from the Mexican Government to construct and maintain an electric street car system in Juarez to connect with the lines of the company in El Paso. Part of the material is on the ground and construction work will begin in a few weeks.

CINCINNATI, OHIO.—The Central Traction Company of Indiana has completed its survey of electric line to connect Indianapolis, Kokomo, Noblesville, Tipton and several other towns and parallel the Lake Erie and Western. Work of construction will commence immediately. The power-house, costing $100,000, will be constructed at Noblesville.

CINCINNATI, OHIO.—The contract between the Southern Traction Company, running from Dayton to Cincinnati, and the Wells-Fargo Express Company has expired and the former company refused to renew. It has announced that express cars would be put on, which will collect and deliver express the same as regularly authorized companies. Dayton will be made the central point and the company will do business over the road leading into Springfield and Urbana also.

OHIO CANAL BANKS.—Not this year will any railroad get the banks of the Ohio canals. They have attempted it, especially the electric lines, and by so doing they would, at a very small expense, be able to build lines offering exceptionally sharp competition to the railroads already constructed and with large capitals to pay dividends upon. Governor Nash has decided that the asked for leases be refused. The State Board of Public Works is apparently pleased with his interference, and leases will not be granted. The Cincinnati, Hamilton & Dayton Railroad has made an exceptionally hard fight against the granting of leases of the banks of the Miami & Erie Canal to an electric railway between Toledo and Cincinnati.

THE AUTOMOBILE.

AUTOCARETTES FOR WASHINGTON.—The Baltimore Automobile Company has about completed its contract for autocarettes to be run on the Washington streets. These vehicles are operated by electric power, the batteries being suspended underneath the body of the car. The batteries weigh a ton each, and will have sufficient capacity to run a car about 25 miles on one charge. The autocarettes will seat 50 people, and will be run at a speed of 10 to 12 miles an hour. They will be in charge of a motorman and conductor, the same as trolley cars. Each car weighs about four tons, and costs about $4,000. Mr. O. L. Gooden is in charge of the mechanical work.

TRENTON INTERSTATE FAIR.—Mr. M. R. Margerum, secretary of the Greater Inter-State Fair Association, sends us the following: The Greater Inter-State Fair of Trenton, N. J., to be held during the days of Sept. 24, 25, 26, 27 and 28 next, has opened an office in New York City, where information concern-

ing the automobile department of the Fair exposition, as well as races, may be obtained. This department is under the direction of Mr. E. E. Schwarzkopf, room 60, Astor Court Building, 25 West Thirty-third Street, New York City. Mr. George F. Chamberlin, acting president of the Automobile Club of America, has accepted, in behalf of his club, the cup which the Trenton Fair Association tendered the Automobile Club of America, to organize a road-run from New York to Trenton, on Sept. 22, the winner of the run to be presented with the cup. The committee on runs and tours of the Automobile Club of America is now organizing the run. It is contemplated that racing machines will give time allowance to the other automobiles entered in the run. To the programme of the automobile races, to take place Sept. 24 on the half-mile track, has been added a motor tricycle race of 10 miles, subject to the following conditions: First prize, $75 plate or cash; second prize, $25 cash; third prize, $5 cash. All prizes awarded if competed for by five or more participants. If only three competitors, first prize only will be awarded. All the floor space originally assigned to the Automobile Exposition Department of the Fair, comprising 25,000 sq. ft., has been taken,and the erection of an annex for the purpose is in contemplation. The time originally set for the closing of entries for the automobile races has been extended to Sept. 20.

OBITUARY.

MR. G. SHOREY.—The death is announced of Mr. George Shorey, an electrical engineer, at one time connected with the Chicago Edison Company, but recently superintendent of the Union Electric Company, of Seattle. He left that position a short time before his death to take charge of the reconstruction of the lighting and railway plant at New Whatcom. Mr. Shorey's death was very sudden, and his host of friends will regret to learn of the sad news.

PERSONAL.

MR. W. J. STOCKER, of Cornwall, England, and K. Shumara, of Tokio, Japan, were two foreign visitors in Pittsburg last week. They inspected the Westinghouse works.

MR. W. F. WHITE, manager of the Edison Electric Company, Cincinnati, is in Saratoga Springs, N. Y., in attendance upon the annual meeting of the Association of Edison Illuminating Companies.

MR. J. H. SULLIVAN.—It is stated that it has been definitely settled that J. H. Sullivan is the man to succeed Mr. McCall as president of the Philadelphia Electric Company, and that the directors have been given to understand that the position will be accepted.

EDUCATIONAL.

CORRESPONDENCE INSTRUCTION.—The prices of scholarship in the International Correspondence Schools, Scranton, Pa., will be increased on Oct. 1. Before that date new students will have the benefit of the lower prices in force at the time of enrolling. Even at the new prices the scholarships are remarkably low and the terms of payment are liberal. A course of instruction by mail in chemistry is announced by the International Correspondence Schools, Scranton, Pa. The course includes mathematics, physics, theoretical, inorganic and organic chemistry, qualitative and quantitative analysis. George Herman Dimpfel, Ph.D., who is in charge of the chemistry course, is a graduate of the University of Leipsic, Germany, and also studied in the Universities of Strassburg and Heidelberg. Later he was an instructor in the latter institution, but was induced to take up commercial work. After an extended experience in Europan cities he came to this country, and is now principal of the School of Chemistry.

Trade Notes.

PARIS GOLD MEDAL.—The Jeffrey Manufacturing Company, Columbus, Ohio, was awarded a gold medal at the Paris Exposition covering its line of elevating, conveying and mining machinery.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has been appointed general western agent for the new socket extension tap, and is engaged in sending out circulars and information regarding it.

MANAGER J. C. HOBART, of the Triumph Electric Company, Cincinnati, reports that his company has never been busier at this season of the year, and has enough work to carry it through, with orders coming in satisfactorily and inquiries increasing.

PLATING DYNAMO.—The Maxwell M. Mayer Electric Company, 2369 Second Avenue, New York, has issued a circular describing its new type of plating dynamos, which machine is made in four standard sizes. Various improvements have been made in this plater, all of which combine to make a highly efficient, simple and reliable machine.

THE CARLISLE & FINCH COMPANY, Cincinnati, has found it necessary to move into larger quarters and is now occupying a factory 60 x 120 feet, five stories high. It reports prospects for fall business in search-light projectors very good, and particularly so in the matter of electrical novelties, in which it reports a greater demand than ever before.

STEEL AWARD AT PARIS.—Mr. W. F. Wagner, general manager of the New York office of William Jessop & Sons, Limited, Sheffield, England, is informed that "Jessop's Steel" has been awarded the Grand Prix at the Paris Exposition. The award is the highest grade, and is for excellence of material and perfection of workmanship. It is of interest to note in this connection that this steel has taken over 20 highest exhibition awards.

EXTENSION OF PLANT.—The Jones Bros. Electric Company, Cincinnati, Ohio, has made a number of improvements in its plant during the summer, including additional boiler capacity of 800 hp. The company has just accepted from the Westinghouse Electric and Manufacturing Company an additional 150-kw generator, direct connected to a 250-hp tandem compound Ball engine. Secretary Hooper believes that the fall and winter business will be very heavy.

THE WESTERN ELECTRIC SUPPLY COMPANY, St. Louis, Mo., describes G. Y. circuit breakers, the Paragon bipolar power motor and some electric controlling devices in a supplement to its catalogue No. 22. The merits of the circuit breakers are pointed out at some length. Various forms are illustrated and the prices for different capacities quoted. The simplicity and handsome design of this apparatus is rapidly introducing it, and its efficient action makes friends for it wherever it goes.

AUTOMOBILE LUBRICATION.—The Siegrist Lubricator Company, St. Louis, Mo., has received a duplicate order from the Imperial Electric Light, Heat & Power Company, of the same city, for the Siegrist automatic oiling system, to be used in connection with some new units now being installed in the Imperial Company's plant. The Siegrist system has been under practical test in the Imperial plant for the past year, and the fact that the Imperial Company has given a duplicate order is evidence that the system has given satisfaction.

BIDS INVITED.—The Memphis Hotel Company invites proposals for the construction of the Hotel Gayoso, to be built in Memphis, Tenn. Bids for the electrical work, power plant, boilers, machinery, telephones, elevators, etc., may be submitted separately or in a lump. Further information may be obtained by addressing Jerome Hill, vice-president of the Memphis Hotel Company, Memphis, Tenn. Bids must be delivered prior to Sept. 24. Plans, conditions and forms of proposals and specifications may be seen and obtained at 84 Adams Street, Chicago, and at the office of Stuyvesant Fish, 214 Broadway, New York.

ELECTRIC MOTORS FOR BLOWING ORGANS.—The adaptibility of electric motors for blowing pipe or reed organs is well known. The Sprague Electric Company, New York, has just issued a bulletin on this subject, pointing out that the blowing apparatus of church organs when operated by a Lundell motor is regular and reliable in its service. The motor is connected directly to the wheel, handle or shaft of the bellows, thus eliminating troublesome belting, shafting and like accessories. The various pieces of apparatus used in the outfit are illustrated and a wiring diagram is given, together with a dimension diagram of the outfit.

TRIUMPH MOTORS.—The Triumph Electric Company, of Cincinnati, Ohio, has received the following from Mr. C. P. Alterberg, manager of the foreign department of the J. A. Fay-Egan Company, Paris Exposition: "We have used five of your 220-volt motors, aggregating 100 hp, to operate our exhibits at the Paris Exposition. Up to date we have not expended one cent in repairs of any kind; our operators give the motors no attention beyond keeping them clean, and the bearings supplied with oil. I feel highly gratified with their performance and take pleasure in so advising you." These Triumph and Egan exhibits have already been illustrated and described in the pages of ELECTRICAL WORLD AND ENGINEER.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED AUG. 27, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

656,635. ELECTRIC MOTOR SUSPENSION; G. Gibbs, Philadelphia, Pa. App. filed Feb. 28, 1898. The motor is hinged upon the axle and has its field magnet on one side thereof and an extension from the frame on the other side. The motor is supported by a cradle, between which and the extension a spring is inserted.

656,636. ELECTRIC MOTOR SUSPENSION; G. Gibbs, Philadelphia, Pa. App. filed May 11, 1900. A modification of the preceding patent.

656,650. SYSTEM OF ELECTRICAL DISTRIBUTION; A. D. Lunt, Schenectady, N. Y. App. filed June 30, 1900. This invention renders it possible to secure the beneficial effects of a multi-phase current from single-phase sources by making use of a multi-phase receiving apparatus, to which are connected a plurality of single-phase dynamo electric machines, held in displaced phase relation to each other through the reaction of their electro-motive forces with those generated by said multi-phase machine.

656,651. METHOD OF TREATING POROUS MATERIAL USED FOR ELECTRICAL PURPOSES; W. A. Markey, Saginaw, Mich. App. filed Jan. 15, 1900. Carbon blocks are treated with nitrate of silver to make them more durable and more conductive.

656,652. CARBON BRUSH; W. A. Markey, Saginaw, Mich. App. filed March 30, 1900. This is the product produced by the method described in patent No. 656,651.

656,672. ANIMAL RELEASING DEVICE; F. A. Sprenger, Chicago, Ill. App. filed Sept. 30, 1899. A thermostat and switch are arranged in an electric circuit containing suitable appliances for releasing the animal either automatically in case of fire, or by hand when desired.

656,680. SYSTEM OF ELECTRICAL DISTRIBUTION; E. Thomson, Swampscott, Mass. App. filed June 12, 1899. Mechanical means for opening the primary circuit are brought into action by the puncture of the transformer insulation, thus preventing the entry of the primary current into the secondary circuit.

656,681. CIRCUIT BREAKER; E. Thomson, Swampscott, Mass. App. filed

June 12, 1899. This circuit breaker is adapted to be used in the system described in the previous patent.

656,703. TELEPHONE SYSTEM; F. G. Rugh, Brief Bluff, Ill. App. filed June 28, 1899. This is a selective mechanism whereby any one of a number of subscribers on a single line may be called without calling the others.

656,716. FLUID OPERATED ELECTRIC SWITCH; C. A. Eck, Newark, N. J. Application filed Feb. 12, 1900. This switch is used for starting and stopping an air pump which supplies air pressure to the surface of beer in casks, and operates automatically by the pressure in the cask.

656,744. DEVICE FOR LIGHTING LAMPS BY ELECTRICITY; S. M. Meyer, New York, N. Y. App. filed March 3, 1898. Details.

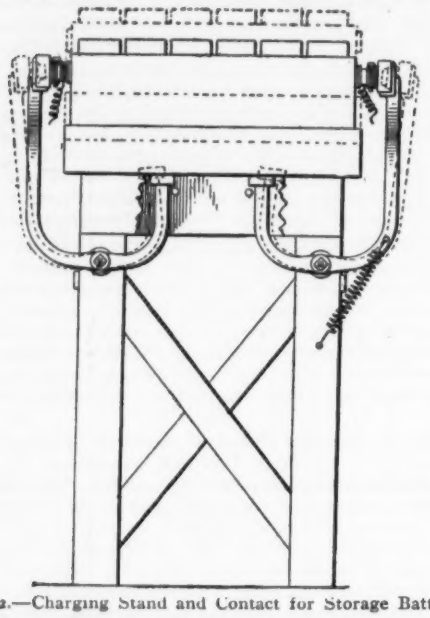
656,780. LIGHTING ARRESTER; W. E. Athearn, New York, N. Y. App. filed Feb. 16, 1898. The arrester comprises a block of non-conducting material having elongated ends, carrying connections for the line and fuses, a central portion to which the ground plate and ground connection are secured, an intermediate connection wound with coils of wire forming part of the line circuit, the ground plate extending from one end of the coils to the other and contiguous thereto.

656,790. TROLLEY; M. T. Schaffer, Bethlehem, Pa. App. filed May 4, 1900. The contact wheels are in a pivoted frame supported by a spring so as to readily rise and fall when inaccuracies in the line are encountered.

656,796. SIGNAL RECEIVING RELAY; G. K. Thompson and E. C. Robes, Medford, Mass. Application filed March 12, 1900. The object of the invention is to provide a relay whereby at any station of a main circuit an alternating current flowing in such circuit may be enabled to steadily close and maintain closed a local circuit containing a signal receiving instrument and effect the satisfactory operation of said instrument.

656,806. ALTERNATING CURRENT GENERATOR; C. S. Bradley, Avon, N. Y. App. filed June 22, 1896. An induction generator comprising a power-driven member magnetized by a rotary field and including a condenser in the circuit, and a generating member in inductive relation to the power-driven member.

656,821. MEANS FOR CONTROLLING ENERGY DELIVERED TO ELECTRICAL TRANSLATING DEVICES; H. W. Leonard, New York, N. Y. App. filed Jan. 31, 1896. In a system of electrical distribution, a main source of supply and a circuit extending therefrom, two dynamo-electric machines, the armatures and field magnets of which are independently connected in series across the circuit, an intermediate conductor extending from the armature-circuit of said machines from a point intermediate the two armatures, a translating device connected in a circuit extending from said intermediate conductor to one of the conductors extending from the source of supply, and a rheostat shunted around the field magnets of the two dynamo-electric machines, by the adjustment of which the strength of each of said field magnets is varied to vary the potential upon the intermediate conductor.



656,882.—Charging Stand and Contact for Storage Batteries.

656,828. TELAUTOGRAPHIC APPARATUS; F. Ritchie, London, England. App. filed Jan. 29, 1900. General improvements throughout the machine.

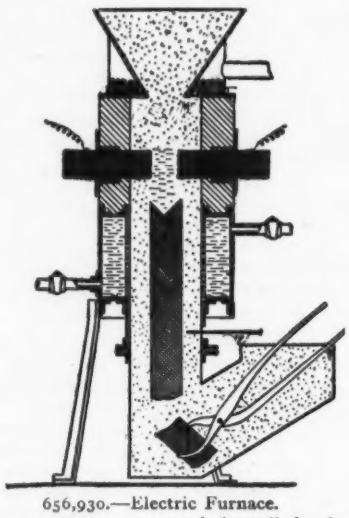
656,822. TELEGRAPHY; H. E. Bartholomew, Newark, Ohio. App. filed Oct. 12, 1899. In this system there are two sets of receiving and transmitting apparatuses, one operating according to the old Morse plan, whether simplex or multiplex, the other operating by high-tension currents, and neither system interfering with the other.

656,870. ELECTRIC SWITCH; R. H. Wappler, New York, N. Y. App. filed Dec. 8, 1899. A switch for dental and surgical appliances, consisting of a rotary disk bearing the contacts and arranged to be quickly and easily manipulated between the thumb and finger.

656,882. CHARGING STAND AND CONTACT FOR STORAGE BATTERIES; G. H. Condict, New York, N. Y. App. filed July 18, 1898. A stand is equipped with a circuit-closing arm, which is moved into position to close the circuit through the battery by the act of placing the tray upon the stand.

656,907. TELEPHONE SIGNALING APPLIANCE FOR PARTY TELEPHONE LINES; Josef Steiner and Wm. H. Tuck, New York. App. filed Jan. 8, 1900. (See Page 381.)

656,923. CABLE HANGER; C. D. Beard, Columbiana, Ohio. App. filed July 6, 1900. The hanger comprises two members pivotally connected together and having prongs for engaging a cable and hooks for engaging the hanger support.



656,930.—Electric Furnace.

656,930. ELECTRIC FURNACE; W. Borchers, Aix-la-Chappelle, Germany. App. filed April 12, 1900. The products of the furnace are cooled by means of a water jacket before they are taken from the furnace to prevent such losses as are unavoidable when the products leave the furnace hot.

656,957. ELECTRICAL SIGNALLING APPARATUS; E. B. Ellicott and L. E. Oehring, Chicago, Ill. App. filed May 2, 1899. Details.

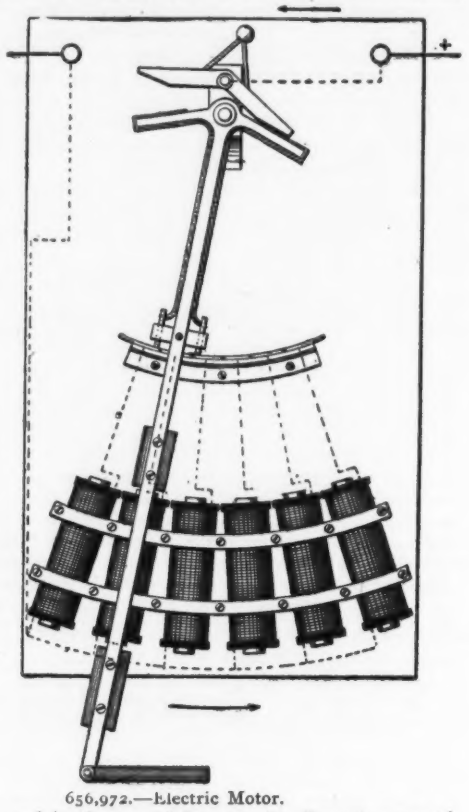
656,961. MEANS FOR SECURING POLE PIECES; H. Geisenhoner, Schenectady, N. Y. App. filed Oct. 6, 1898. The pole pieces are secured simultaneously in dove-tailed grooves in the periphery of the wheel by a series of tapered bolts, which pass through a locking ring. By setting up the bolts the ring is forced into locking engagement with the pole pieces.

656,972. ELECTRIC MOTOR; E. A. Henry, Crestline, Kan. App. filed March 21, 1900. The moving part of the motor is a pendulum carrying an armature which is successively attracted by magnets arranged in the path of travel of the pendulum, and whose circuits are successively closed by the pendulum itself.

656,977. ELECTRIC LAMP FOR MINER'S USE; L. Horwitz, Berlin, Germany. App. filed Feb. 21, 1899. Details.

656,982. ELECTROLYTICALLY TREATING SCRAP TIN; E. D. Kendall, New York, N.Y. App. filed Nov. 20, 1899. An electro-chemical process for effecting the complete separation of tin and iron and the subsequent separate recovery of the same.

656,996. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARD; F. R. McBerty, Evanston, Ill. App. filed July 25, 1898. The object is to provide a single supervising indicator with means for bringing the indicator at one time under the control of one of the lines and subsequently under the control of both of the lines, to indicate in the first instance the response of the called subscriber, and in the second instance the discontinuance of conversation.



656,972.—Electric Motor.

656,997. SIGNAL FOR TELEPHONE TRUNK LINES; F. R. McBerty, Evanston, Ill. App. filed Jan. 29, 1900. It consists of a clearing-out signal for one terminal of the trunk line and means for controlling it from the other terminal of the trunk line, the purpose of the improvement being to effect such control without the aid of earth connections during the use of the trunk line for conversation.

657,012. APPARATUS FOR ELECTROLYSIS; P. Schoop, Wildegg, Switzerland. App. filed Aug. 17, 1899. The invention relates particularly to the construction of the electrodes, which are long strips S-shaped in cross section, one part of which is located in one of the channels or cells, while the other projects over into the next channel.

657,020. PORTABLE ELECTRIC LAMP; F. W. Brooks, Washington, D. C. App. filed June 9, 1900. Details.

657,032. APPARATUS FOR ELECTROLYZING ORES; A. M. Rouse, Denver, Colo. App. filed Nov. 1, 1899. Consists of a tank, in which the ore is deposited with a solvent, and a centrally-located tube arranged in the tank, containing an agitator, through the operation of which the ore and solvent may be conveyed from the main portion of the tank into and up through the centrally-located tube in such a manner that the solvent falls slowly in the main portion of the tank and drives it rapidly in the central tube.

657,046. MULTIPLE MOTOR SYSTEM FOR AUTOMOBILES; J. Trier, Chicago, Ill. App. filed April 26, 1900. An axle having a traction wheel mounted thereon, a shaft, a plurality of motors carried by the shaft for rotating the same, and gearing connecting the shaft and axle.